

**Acute exacerbation of COPD:
length of hospital stay, readmission rates and
patients' experience of a hospital at home programme**

A combined quantitative and qualitative approach

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Summary

Backgrounds: Chronic obstructive pulmonary disease (COPD) is one of the most common chronic diseases in the world, and it is expected to become the third leading cause of death worldwide in 2030.

Exacerbation is a major event in the natural history of COPD, and repeated exacerbations result in reduced quality of life, accelerated lung function decline and increased risk for death, particularly in those requiring hospitalization. The length of hospital stay (LOS) is usually long (6-10 days) and readmission rate is high (up to 60% in the following year).

A wide range of factors have been associated with prolonged LOS with little consistency between the studies. Many of the factors reported are related to disease severity and/or aging and therefore are not amenable for intervention. Both hospital organizations and resources and clinical pathways have been shown to reduce LOS. Few published studies based their analysis on variables gained from emergency rooms, and to our knowledge, no predicting model has been established for LOS based on these variables.

Readmission rate is a challenge to the traditional health care system. Most of the interventions reducing readmission rate have been carried out after discharge and applied new elements in healthcare services, e.g. patient education emphasising self-management and long term follow-up by multidisciplinary team. There is limited information about whether treatment of acute exacerbation in a specialised pulmonary department contributes to lower readmission rates than treatment in other internal medicine departments.

Hospital at Home (HaH) with assistant early discharge, a new health care service, has been shown to shorten the hospital stay and reduce the readmission rate compared to traditional hospital treatment for selected patients with acute exacerbation of COPD. Moreover, patients receiving home treatment were more satisfied and would prefer home treatment in the future. However, there is a lack of detailed information about what these HaH patients were satisfied with and why they preferred this form of health care.

In Norway, as in other industrialized countries, COPD exacerbation is one of the most common causes of hospital admission in the internal medicine department. In spite of this fact, the data about the exacerbation-related outcomes of hospitalized patients are still sparse.

Further, HaH has not been tried out and thus lack of literature of the patients' experiences with HaH. Therefore the aims of this thesis are:

1. To identify the predictors of long LOS when hospitalized for acute exacerbation of COPD and to establish a predicting model for LOS based on variables available in emergency room on admission
2. To determine whether COPD patients treated in specialized Pulmonary Department had lower readmission rates than comparable patients treated in other medicine departments at the same hospital
3. To explore patients' experiences with a HaH programme with assistant early discharge program after hospitalization for acute exacerbation of COPD

Methods: The medical records of 599 patients hospitalized for acute exacerbation of COPD at Oslo University Hospital, Aker between March 2006 and December 2008 were collected retrospectively in order to answer the first and second research questions. We registered the following data: LOS of the first hospitalization in the defined period (index admission), number of COPD-related readmissions in the following 12 months after the index admission (readmission rate), and patients' demographic and medical data that were readily available in the emergency room on admission. We used multivariate logistic regression analysis to assess the association between variables on admission and long LOS and a receiver-operator characteristic (ROC) analysis was performed to assess the performance of the predicting model. A propensity-matched pair analysis was used to select comparable patients discharged from the Pulmonary Department and the other medicine departments. Paired *t*-test was used to compare the readmission rates of the matched patients discharged from the Pulmonary Department and other medicine departments.

To answer the third research question, we used data collected from semi-structured interviews of nine patients who participated in a randomised controlled trial (RCT) assessing the long term effect of a HaH programme for patients hospitalized for acute exacerbation of COPD. Six participants were randomised to receive HaH care and three to receive traditional hospital care. The interviews were audio-taped, transcribed and analysed by a four-step method for systematic text condensing.

Results: Results are presented in three papers. The main findings are:

Admission on Thursday-Saturday, co-morbidities, high partial arterial tension of CO₂ and low serum albumin level were associated with a long LOS. The predicting model was less successful and had area under the curve 0.7, which means a less satisfactory predictability.

We found a non-significant trend of lower readmission rate in favour of patients discharged from the Pulmonary Department after an acute exacerbation episode of COPD one year following the index admission.

Patients receiving home care experienced the HaH programme as safe. They expressed that information they gained from this programme was adapted to specific situations in their daily lives and given in a familiar environment which had a positive impact on their self-management of COPD.

Discussion: Reasons for a prolonged LOS and high readmission rate are probably multifactorial and may indicate the need for better chronic care, as highlighted by findings in our qualitative study: patient involvement and a need for adapted information and follow-up. This is important for developing new and effective health services for patients with chronic disease.

Knowledge about predictors of prolonged LOS may help physicians identify patients at risk of a long LOS in the early stages of an AECOPD admission and therefore may assist discharge planning. Although the readmission rate for patients treated and discharged from a pulmonary department is not significantly lower than comparable patients discharged from other medicine departments, there may be other benefits of being treated in a specialized pulmonary department, as documented in other studies.

List of papers

Paper I

Ying Wang, Knut Stavem, Sjur Humerfelt, Fredrik A. Dahl, Torbjørn Haugen. Predictors of long length of stay when hospitalized for acute exacerbation of chronic obstructive pulmonary disease. [Submitted]

Paper II

Ying Wang, Knut Stavem, Sjur Humerfelt, Fredrik A. Dahl, Torbjørn Haugen. Readmissions for COPD: propensity case-matched comparison between pulmonary and non-pulmonary departments. *Clin Respir J* 2013 oct;7(4):375-81. doi: 10.1111/crj.12018. Epub 2013 Mar 20.

Paper III

Ying Wang, Sissel Steihaug, Torbjørn Haugen, Anne Werner. Patients with acute exacerbation of chronic obstructive pulmonary disease feel safe when treated at home: a qualitative study. *BMC Pulmonary Medicine* 2012, 12:45

Selected abbreviations

AECOPD	Acute exacerbation of chronic obstructive pulmonary disease
AF	Atrial fibrillation
ATS	American Thoracic Society
BMI	Body mass index
CI	Confidence interval
COPD	Chronic obstructive pulmonary disease
DALY	Disability-adjusted life year
ERS	European Respiratory Society
FEV ₁	Forced expiratory volume in 1 second (litre/second)
FVC	Forced vital capacity (litre)
GOLD	Global Initiative for Chronic Obstructive Lung Disease
HaH	Hospital at home
IL	Interleukin
IQR	Inter-quartile range
LOS	Length of stay
LTOT	Long term oxygen therapy
NIV	Non-invasive ventilation
PaCO ₂	Partial arterial tension of carbon dioxide
QALY	Quality adjusted life year
SD	Standard Deviation
TORCH	TOWard a Revolution in Copd Health
WHO	World Health Organization

1 Introduction

1.1 *Chronic obstructive pulmonary disease*

Until the late 1950s, there was profound international confusion about the use of terms such as emphysema, chronic bronchitis and asthma. One of the first attempts to propose a term to cooperate all these three existing terms was at the Ciba Guest Symposium in 1958. In the symposium report published in 1959, “chronic non-specific lung disease” was proposed to include all three conditions and “generalized obstructive lung disease” including “reversible” and “irreversible obstructive lung disease referred to asthma and emphysema.”¹ Shortly after the Ciba symposium, the term “chronic obstructive pulmonary disease (COPD)” was introduced in North America, referring to patients without atopy and with minimal reversibility of the air flow limitation. In 1984, Fletcher and Pride revised the terminology COPD and in 1987 the American Thoracic Society (ATS) made a consensus statement of COPD which included asthma in the definition by using a Venn diagram.^{2,3}

In 2001, the Global Initiative for Chronic Obstructive Lung Disease (GOLD), as a project of the World Health Organization (WHO) and the U.S. National Heart, Lung, and Blood Institute, released a consensus report and defined COPD as “a disease state characterised by airflow limitation that is not fully reversible” which is associated with “an abnormal inflammatory response of the lung to noxious particles or gases.”⁴ This was the first time that “inflammation” was incorporated into the definition of COPD. The report was revised in 2006 and 2011 in addition to the annual update. In the last version, co-morbidity and exacerbation were taken into the definition for the first time and the assessment of COPD was no longer based solely on the spirometry documented airflow limitation but on the combination of patient’s symptom level, existing co-morbidities and future risk of exacerbation. This illustrated the increasing knowledge of the nature of COPD as a systemic disease with multi-organ affection and the importance of patient aspects of this disabling disease.⁵

1.1.1 **Definition, diagnostic criteria and risk factors**

According to GOLD, COPD is a common preventable and treatable disease characterized by persistent airflow limitation that is usually progressive and associated with an enhanced chronic inflammatory response in the airway and the lung to noxious particles or gases. Exacerbations and co-morbidities contribute to the overall severity in individual patients.⁵

The combination of symptoms, exposure to risk factors and persistent airflow limitation are required to diagnose COPD. The cardinal symptoms are dyspnea, chronic cough or sputum production. The most common risk factors are tobacco smoke, smoke from home cooking and heating fuels, occupational dusts and chemicals or family history of COPD. Spirometry has to be performed and post-bronchodilator fixed ratio of forced expiratory volume in 1 s (FEV₁)/forced vital capacity (FVC) < 0.70 is required to confirm the diagnosis of COPD.

1.1.2 Pathology and pathophysiology

The chronic inflammatory process elicited by cigarette smoking or other noxious particles involves all anatomical regions of the lung, i.e. airways, lung parenchyma and vasculature.⁶ Although the exact mechanisms for the inflammatory process are still unknown, oxidative stress, protease-antiprotease imbalance and genetic factors play a role.⁷ The inflammatory process is facilitated by different types of mediators (chemotaxines, cytokines and growth factors) released by inflammatory cells such as neutrophils, macrophages.⁸ Persistent inflammation, even after smoking cessation, causes continuous tissue damage in the entire tracheobronchial tree and lung parenchyma with subsequent repair and results in a permanent structural and functional change.⁹

It is clear now that chronic inflammation exists not only in the patient's lung but the whole system although how and why is still unknown. One theory is that systemic inflammation is a result of a "spill over" of inflammation in the lungs to the systemic circulation.¹⁰⁻¹³ Other theories have also been described.^{4,14,15}

The complexity of the pathogenesis of COPD is reflected in the broad variation of clinical phenotypes. The term "chronic systemic inflammatory syndrome," suggested to be added to the diagnosis of COPD, reflects the complexity of the problem.¹⁶ Thus one management regime could not possibly fit all patients, and individual assessment is necessary.

1.1.3 Co-morbidities

We know that co-morbidities are common at any severity level of COPD and they have a significant impact on a patient's prognosis.¹⁷⁻²⁰ In fact, many patients with COPD die of non-respiratory diseases such as cardiovascular disease (~25%), cancer (mainly lung cancer, 20-33%) and other causes (30%).²¹⁻²⁴ Respiratory failure accounts for up to 40% of deaths

primarily in patients with severe COPD, depending on the population studied and criteria used.²⁵

The most frequent co-morbidities in COPD are cardiovascular diseases, including ischemic heart disease, heart failure, atrial fibrillation and hypertension. Other common co-morbidities are osteoporosis, metabolic syndrome, diabetes, lung cancer, anaemia, malnutrition, atrophy and dysfunction of skeletal muscles, pulmonary vascular disease, physical intolerance, anxiety and depression (figure 1).

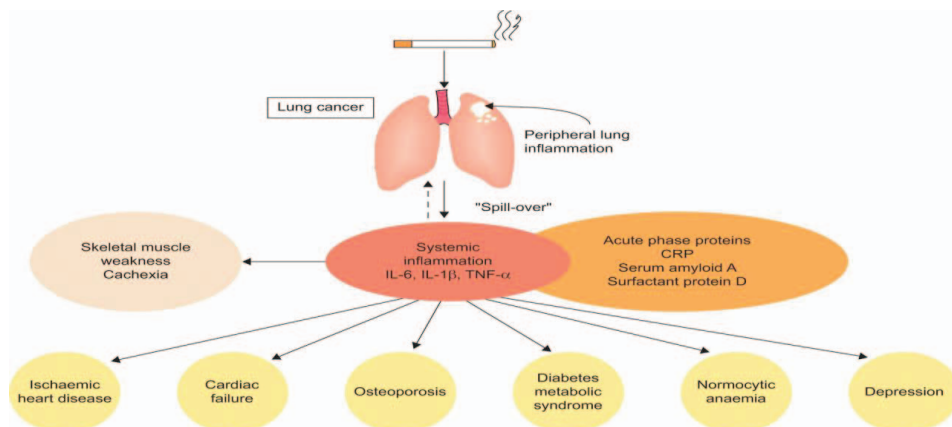


Fig. 1. Systemic effects and co-morbidities of chronic obstructive pulmonary disease (COPD). Barnes and Celli.

Reproduced from Eur Respir J 2009; 33: 1165-1185. Peripheral lung inflammation may cause a "spill-over" of cytokines, such as interleukin (IL)-6, IL-1 β and tumour necrosis factor (TNF)- α , into the systemic circulation, which may increase acute-phase proteins such as C-reactive protein (CRP). Systemic inflammation may lead to skeletal muscle atrophy and cachexia and may initiate and worsen co-morbid conditions. Systemic inflammation also may accelerate lung cancer. An alternative view is that systemic inflammation causes several inflammatory diseases including COPD.

In contrast to other co-morbidities, anxiety and depression, with a higher prevalence in more severe COPD, often remain undiagnosed and untreated.^{26,27} Depression increases the risk of exacerbation, frequent admission and poor survival.²⁸⁻³⁰ The exact mechanism of depression is unknown, but it has been supposed to be multi-factorial.³¹ Risk factors such as age, smoking, hypoxemia and decline of health status, as well as systemic inflammation with IL-6, may play a role in the pathogenesis of the development of depression in COPD.³²

In 2011, the GOLD Initiative for first time introduced a multi-dimensional tool to assess COPD's severity and the future risk of exacerbation. Although the degree of airway obstruction, FEV₁, is still important in assessing COPD, it has been realized that FEV₁ is only weakly correlated with patients' symptoms and health-related quality of life.^{5,33,34} Rodriguez-Roisin and Agusti have called this a change of paradigm in their comments in the latest version of GOLD's strategy report.³⁵ Other aspects of COPD that are gaining more attention

during the past decade include dyspnea, exacerbations, co-morbidities including psychological disorder, regular physical activity, exertional desaturation, peripheral muscles, body composition, nutritional status, hormone balance, effort intolerance, and quality of life.³⁶ This illustrates the beginning of a new era: a more individualized assessment and treatment of this complex disease.

1.1.4 The natural history of COPD

This heterogeneous and complex disease has probably more than one natural history.³⁷ The disease is usually progressive and has no cure, and may lead to death. The time frame of progression is generally long and has wide individual variations. While cough and sputum are the predominant symptoms in some patients, dyspnea may be the only symptom in others. Some individuals show a rapid decline in lung function, while others show a slow, roughly stable decline. Stopping exposure to noxious agents related to COPD may slow the disease progression, and regular treatments may control symptoms and improve quality of life. As a consequence of this complexity, the discrepancy of reported mortality is large among COPD patients. While the TORCH study, based on outpatients with COPD, reported a three-year mortality of 14.3%, the mortality rate dramatically increased in patients who had been hospitalized for COPD exacerbations.³⁸ Three- and five-year mortality after hospitalization increases to 55 and 75% respectively.^{39,40} Thus, knowledge about how to prevent hospitalization and reduce readmission is important for improve prognosis for this patient group.

1.1.5 Socioeconomic burden

COPD is one of the most common chronic diseases in the world, and the World Bank/World Health Organization projects it will be the third leading cause of death and fifth leading cause of morbidity by 2020.⁴¹ The prevalence among adults in Europe, Australia and North America ranges from 4% to 10%.⁴² Based on a Hordaland County cohort study, the prevalence of GOLD-defined COPD in Norway is 7% and the prevalence of earlier GOLD-defined severe and very severe disease is 1%.⁴³ The average annual incidence of COPD in the general population aged 18-74 years is approximately 0.7%.⁴⁴

The social burden is less obvious and more complicated to estimate. The disability-adjusted life year (DALY) estimates the overall burden of a disease, expressed as the number of years

lost due to ill-health, disability or early death.⁴⁵ The COPD was the 11th leading cause of lost DALYs in the world in 2002 and it was expected to climb to 7th place in 2030.⁴⁶

The economic and social burden of COPD is substantial and still increasing.⁴⁷ According to the European Lung White Book published by European Respiratory Society (ERS) in 2003, the estimated annual direct costs of COPD in the European Union are € 38.6 billion.⁴⁸ The corresponding estimation in the U.S. was \$29.5 billion and the indirect costs are \$20.4 billion.⁴⁹ In Norway, the estimated direct medical costs for people aged ≥40 yrs in 2005 was approximately € 141 million.⁵⁰ The cost of hospital admission is the most important direct cost in the economic evaluation of COPD.⁵¹ Hospitalization represents more than 40% of the overall costs of COPD care, and for the most severe patients, it can be more than 60%.^{52,53}

1.2 Exacerbation

1.2.1 Definitions and classifications

Both symptom- and event-based definitions of exacerbation have been described in the literature. The symptom-based definition was described by Anthonisen et al. and required worsening or increased dyspnoea, with or without sputum and sputum purulence.⁵⁴ The ISOLDE Study suggested the treatment-based definition at the beginning of the 21st century; it said exacerbation should lead to changes in treatment.³³ GOLD defined exacerbation as an acute event characterized by a worsening of the patients' symptoms that is beyond day-to-day variation and leads to a change in medication.^{35,55,56}

Exacerbation has been increasingly recognized as an important event in the natural history of COPD. The growing evidence in the past decade showed that exacerbations negatively affect the patients' quality of life, worsen the symptom and lung function, which may take weeks to recover, accelerate lung function decline and increase mortality, particularly in those requiring hospitalization.^{39,57} Furthermore, the socioeconomic costs are high.^{58,59}

No single biological marker has been proved to be capable of assessing the severity of exacerbation yet. The American Thoracic Society (ATS) and European Respiratory Society (ERS) proposed the most common classification based on the treatment required for the current exacerbation. The three degrees of severity are as follows: **mild**, an increase in respiratory symptoms controlled by the patient with an increase in the usual medication;

moderate, requiring treatment with systemic glucocorticosteroids and/or antibiotics; and **severe**, requiring hospitalization or a visit to the emergency department.⁶⁰

1.2.2 Length of hospital stay in hospitalization for exacerbation

Hospitalization is common for patients with severe exacerbation. The average length of stay (LOS) for patients hospitalized for acute exacerbation of COPD is long and the variation of reported LOS is large—it ranges from 3 to 16 days, probably due to the population studied.^{61,62} There is no established standard LOS for COPD exacerbation. Prolonged LOS increases the risk of adverse events and may reinforce the negative effect of hospitalization. Both long and short LOS had been associated with an increased risk for readmission. Saynajakangas found that LOS of shorter or longer than 7 days was associated with an increased risk of readmission.⁶³ Sin et al. observed that although patients with hospital stay of less than 4 days were younger and had less co-morbidity, they were 39% more likely to be readmitted and 45% more likely to die within 15 days of discharge than those who stayed 4 to 6 days. Furthermore, the risk was highest among patients whose stay was less than or equal to 1 hospital day.⁶⁴ While premature discharge may result in a “swing door” phenomenon as proposed by Capewell, the prolonged LOS may indicate more fragile patients and therefore an increased risk of readmission.^{65,66}

Different variables are associated with long LOS in acute exacerbation of COPD, such as social/demographic data, clinical variables, co-morbidities, number and type of drugs used and day of the week for admission.^{30,62,63,67-74} However, there is little consistency in the predictors of long LOS between different studies.

Since patients with long LOS may be more fragile and need more help after hospitalization, they need to be identified to optimize discharge planning. Few studies have assessed LOS based on variables obtained in the emergency room. To the best of my knowledge, there are no statistical models to predict LOS based on variables collected at the time of hospital admission for acute exacerbation of COPD. Increased knowledge about predictors of length of stay (LOS) may contribute to better discharge planning and shortening the LOS.

1.2.3 Readmission

Patients who have had a hospitalization for acute exacerbation of COPD have an increased risk of readmission because earlier hospital admission for exacerbation is the most consistent

single predictor of rehospitalisation.⁷⁵ This factor is a non-modifiable risk factor that may be a surrogate marker of disease severity. Also dyspnoea, oral corticosteroids, using LTOT, low health status, and not having routine physical activity were all associated with an increased risk of readmission.⁷⁵⁻⁷⁸ Moreover, readmission rates are high, and up to 63% of patients are readmitted within one year after hospitalization for acute exacerbation of COPD.^{75,78} Consequently, the reduction of rehospitalisation may improve the patient's prognosis and reduce the socioeconomic burden of the disease.

The high readmission rates illustrated the challenge the health care system faces with COPD as a progressive chronic disease. As mentioned earlier, the most of interventions that reduce readmission rates are performed after hospital discharge and include self-management education, multidisciplinary team involvement and long term follow-up.⁷⁹⁻⁸²

To my knowledge, there has not been published intervention studies aimed at reducing of readmission before hospital discharge. Several observational studies about the impact of hospital organization on readmission have been published. The UK National COPD Audit 2003 found no association between an increased use of respiratory consultants or better organized inpatient care and readmissions.⁸³ While one US study showed no differences in readmission rate between patients treated by hospitalists, general internists or family physicians, a Finnish study showed that the readmission risk of patients with COPD treated by general practitioners was nearly twice that of patients treated by specialists.^{84,85} The high COPD readmission rate remains a challenge to health care services.

1.2.4 Patient perception of acute exacerbation

The wide negative impact of acute exacerbation has been clearly documented.^{22, 44,45,48-51} The negative effects of hospitalization itself such as immobility and risk of falls in older people, accentuation of the existing social isolation, and depression, are well known.⁸⁶⁻⁸⁹ Depression and anxiety persist in a high percentage of patients even after the discharge, which in turn increases the risk of readmission.^{77,90}

However, the literature about patients' experiences of acute exacerbation is limited, although there are some qualitative studies about patients' experiences living with advanced COPD.^{91,92} One quantitative survey studied the impact of exacerbation on a patient's daily life without providing detailed description of patients' experiences of exacerbation.⁹³ One observational

study of 125 patients from five countries, which used a qualitative design, but presented its findings in quantitative way with diagrams and numbers, showed that anxiety evoked the patients' most concern because they were worried about dying, suffocating, worsening of their condition and hospitalization.⁹⁴ The same study also documented the considerable impact of acute exacerbation on the patient's family that causes fear and worry.

By interviewing patients and their family caregivers within 24 hours of hospitalization for acute exacerbation, Bailey wrote an article called "Death Stories".⁹⁵ This was the first qualitative study carried out while patients were acutely ill and still receiving intravenous steroids and antibiotics. According to the author, eight of the ten family units told death stories. "These death stories usually portrayed two kinds of acute dyspnoeic episodes. They described either a distinct moment in time when the participant thought they or the person they had been caring for had died (and been resuscitated)—a near-death story—or an incident when the storyteller feared dying or witnessing a death event—a shadow-of-death story". This illustrated how dramatic acute exacerbation may be for the patients and their families.

1.2.5 Relieve the burden of exacerbation: the role of new care models

Both quantitative and qualitative studies have shown the obvious negative impact of exacerbation on patients, their families and society, as mentioned earlier. Therefore, good disease control aimed at preventing exacerbation or prompt treatment of exacerbation when exacerbation is already there is of great importance. Several new forms of health care have shown potential in better disease control.

1.2.5.1 Hospital at Home with assistant early discharge

Hospital at home (HaH) has become a common health service in some countries as a response to increased demand for acute hospital beds.⁹⁶ Although the variety of schemes within the concept of HaH is considerable, there is a common feature—patients treated by HaH would be admitted to hospital if HaH care was not available. The HaH admission avoidance regime recruits patients directly from the community by general practitioners or the emergency department. HaH with assistant early discharge recruits patients from those already hospitalized. In this study, I will concentrate on HaH with assistant early discharge.

Evidence from several randomised and controlled trials (RCT) from different countries showed that selected patients hospitalized for acute exacerbation of COPD can be treated at

home safely with the support of a respiratory nurse.⁹⁷⁻¹⁰³ Usually, after up to 3 days of hospital stay, patients who satisfied the criteria were discharged after randomized to home treatment and followed up by a respiratory nurse with home visits over a period of up to 2 weeks or longer. The nurse could consult to a pulmonologist if necessary. If conditions worsen, the patients could be readmitted to hospital directly. A Cochrane review concluded that patients receiving HaH care had a significantly lower readmission rate and a non-significant trend to lower mortality than patients who received conventional hospital care.¹⁰⁴

In spite of the promising results of the HaH programme, it is important to be aware of the danger of burden shift when moving acute hospital care to home, e.g., family members being inflicted with an extra burden.¹⁰⁵ Some studies have explored the issue. A survey study from the US concluded that family members of HaH patients at lower rates experienced potentially stressful situations, and that when such situations occurred, they were less often associated with self-reported stress.¹⁰⁶ The results agree with another study of self-reported stress of caregivers to HaH patients in other diseases.¹⁰⁷

1.2.5.2 Integrated care

Integrated care, which combines hospital and home treatment for patients with complicated diseases, is one way to reduce the pressure on hospital beds.¹⁰⁸⁻¹¹⁰ The American Thoracic Society workshop report defined integrated care as “a continuum of patient-centered service organized as a care delivery value chain for patients with chronic conditions with the goal of achieving the optimal daily functioning and health status for the individual patient and to achieve and maintain the individual’s independence and functioning in the community.”¹¹¹ The chronic care model proposed by Wagner provides a template for integrated care that encompasses six key components: self-management support, clinical information system, delivery system redesign, decision support (guidelines), healthcare organization, and community resources.^{112,113} The literature on other chronic diseases has shown that integrated care may contribute to improved function capacity, higher quality of life, and enhanced possibility to live at home with less help.¹¹⁴⁻¹¹⁶

In COPD, this form of care is still in the early developing stage. Bourbeau et al. showed that intervention promoting a self-management programme supported by a skilled case manager and continuous telephone follow-up reduced hospitalization and improved patients’ health status.¹¹⁷ Casas et al. showed that shared care arrangements after hospitalization among

different levels of the health system can reduce subsequent hospitalization.¹¹⁸ Koff et al. reported on the significant improvement of health-related quality of life, earlier detection of COPD exacerbations, and a trend toward a reduction in health care utilization of proactive integrated care for patients with very severe COPD.¹¹⁹ Rice et al. reported on the reduction of emergency department visits and hospitalizations in patients with severe COPD.¹²⁰

As the socioeconomic burden of chronic disease increases, the resources in the health care system need to be utilized more efficiently. Hospitals have disease-specific competence but a limited capacity to handle the large population of chronically ill patients. In the primary care, physician has closer contact with patients and a better overview of patients and their home situations and therefore can offer more holistic care. The combination of primary and hospital care may offer chronically ill patients more comprehensive care.

1.2.5.3 Multidisciplinary care

COPD patients suffer from a large range of co-morbidities and, together with their family, need to cope with a wide range of problems such as symptoms, disabilities, emotional distress, complex medication regimens, difficult lifestyle adjustments and obtaining help for medical care for the rest of their life.¹¹³ Therefore, care including collaboration between different professionals is important. Pulmonary rehabilitation is an example of multidisciplinary care. There is strong evidence of its positive effects on dyspnoea, exercise performance, health-related quality of life, physical and emotional functional status and reduced health care use in stable COPD patients.¹²¹ Recently, it also has been shown that early pulmonary rehabilitation immediately after hospital admission for acute exacerbation of COPD is a highly effective and safe intervention to reduce hospital admissions and mortality and to improve health-related quality of life.⁸²

The challenge to pulmonary rehabilitation is that its benefits decrease gradually over time. Without follow up after pulmonary rehabilitation, the patients run the risk of unhealthy transitions, of returning to a vicious cycle of inactivity, physical deconditioning and social isolation during the shifting and progressive course of their illness.^{122,123} This is confirmed by a Norwegian qualitative study that showed that the patients experienced the period after rehabilitation as challenging and expressed the need for extended support from both professionals and peers in this critical period when new practices were going to be implemented and motivation of self-management maintained.¹²⁴ Thus, incorporating

principles of pulmonary rehabilitation into the existing health care system and home settings may be the subject for future practice.

1.2.5.4 Self-management: the central element in the new care models

Self-management is the cornerstone of integrated care, chronic care model and multidisciplinary care. The term applies to any formalized patient education programme aimed at teaching the skills necessary to carry out medical regimens specific to the disease, guide health behaviour change, and provide emotional support for patients to control their disease and live functional lives.¹¹⁷ This is accomplished by (1) formulating treatment goals relevant to the patient, (2) encouraging patients to experiment with adaptive behaviours in everyday situations, (3) encouraging problem-solving and decision-making, and (4) promoting self efficacy.¹¹¹

The most important component of a self-management approach in COPD is probably the instruction in the prevention and early treatment of COPD exacerbation through an action plan. Although the details might differ, the recognition of deterioration in symptoms and the initiation of predetermined steps, including starting medications such as oral steroids and antibiotics and promptly communicating with a healthcare provider, are essential contents in these action plans.¹²⁵ The early recognition of exacerbation symptoms followed by early treatment reduces the duration of exacerbation and/or hospital admission rate.¹²⁶

A meta-analysis of self-management education in COPD consisting of eight trials concluded that this intervention was associated with a reduction in hospital admission and improved health status.⁸⁰ Because of the diversity of programmes, the review could not make specific recommendations on content or format of the intervention. With help of self-management strategies, patients may get a more active role in control of this chronic and progressive disease. However, self-management by itself is not enough—the needs for expert support in decision-making and behaviour changes in the long term is necessary.⁷⁹

1.2.6 Patient experience of new care models

All these care systems mentioned above were developed to improve disease control and improve the chronically ill person's quality of life. However, studies about the detailed description of patient's experience with these care models are sparse. A survey showed more satisfaction in patients in the HaH programme than patients receiving traditional hospital care, and patients and carers would prefer HaH in the case of new COPD exacerbation requiring hospital admission.¹⁰⁰ However, it did not describe what the patients were satisfied with and why patients preferred HaH. The design of the study might explain this. Surveys, quantitative studies, are suited to comparing differences but they are not able to give in depth descriptions of how and what. On the other hand, qualitative studies can explore phenomena like this in more details and find out what make patients prefer HaH over traditional hospital care.

Clark et al. explored the experiences of a HaH programme and concluded that not all patients found the home nursing component of the service helpful, and that the patients felt they were not being actively involved in the early discharge process.¹²⁷ In a quantitative study, Schofield et al. showed that the patients and their families preferred home treatment delivered by a nurse-led acute respiratory assessment service; they followed up with a qualitative study to understand what made patients prefer home treatment. In their qualitative study, the patients expressed that the reasons for their satisfaction and preference were the accessibility and ease of use of the service, specialist clinical skills of the health professionals, and one-to-one care in the home (familiar environment) by the friendly and approachable nurses. Monninkhof et al. showed that patients who participated in a comprehensive self-management programme—including self-management education and a fitness programme in an outpatient clinic—felt safe.¹²⁸ The patients attributed this feeling to frequent follow-up and 24-hour accessibility of the hospital and a low barrier to seeking help. However, a detailed description of the patients' experiences of the home treatment programme is lacking and more research is needed.¹²⁹

2 Aims

COPD is a progressive and complex disease with multi-organ affection. Although only a minor proportion of patients will be hospitalized for COPD, the total socioeconomic burden of hospitalization and the distress for patients and their caregivers are considerable. The negative consequences of exacerbations are clearly documented and the prognosis of patients with severe exacerbation requiring hospitalization is poor; the hospital stay is long, the readmission rate is high and both short- and long-term mortality is high. A wide range of clinical and demographic parameters are associated with long hospital stay with little consistency between studies. Few studies have assessed the effect of what department patients are admitted to on readmission rate. To release the increased pressure on hospital beds, Hospital at Home (HaH) with supported early discharge for selected patients admitted for acute exacerbation of COPD has had promising effects on length of hospital stay and the readmission rate. However data on patients' experiences of HaH are sparse.

In Norway, as in other industrialized countries, acute exacerbation of COPD is one of the most common causes of hospital admission in the internal medicine department. In spite of this fact, the outcome data of hospitalized patients are still limited. Therefore this study will:

1. Identify the factors associated with long length of stay when hospitalized for acute exacerbation of COPD and try to establish a predicting model for long length of stay based on variables available at emergency room on admission
2. Determine whether COPD patients treated in a specialized pulmonary department had lower readmission rates than comparable patients treated in other internal medicine departments at the same hospital
3. Explore patients' experiences of a HaH with supported early discharge program after hospitalization for acute exacerbation of COPD

3 Materials and methods

3.1 *The quantitative studies (paper I and II)*

Different data are needed to answer the research questions. Quantitative data from a review of medical records were used to answer the first and second research question, and qualitative data from in-depth interviews were used to answer the third research question.

3.1.1 Study population

The study population in the quantitative studies consists of patients admitted to Oslo University Hospital, Aker, for exacerbation of COPD from March 2006 to December 2008. Patients belonging to one of the following three diagnosis categories were considered as patients with COPD-related admissions and included in this study: 1) primary discharge diagnosis was COPD (J43-44), according to ICD-10 (International Classification of Diseases, 10th revision),¹³⁰ 2) pneumonia (J12-J18) as primary diagnosis with COPD (J43-J44) as a secondary diagnosis; 3) respiratory failure (J96) as primary diagnosis with COPD (J43-J44) as a secondary diagnosis. Patients with COPD-related admission but incomplete medical records during the 12 months after discharge were excluded. For patients with multiple admissions in the inclusion period, the relevant data from the first admission, or index admission, were extracted.

After searching the hospital register for ICD - 10 inclusion criteria, 599 patients were identified. Of these, 33 patients died in the hospital and 566 were discharged alive. In paper I we studied the whole population, and in paper II we studied only those discharged alive.

3.1.2 Data collection

The computerized medical records of all included patients were manually reviewed. Demographic, clinical and administrative data on the index admission were extracted. Demographic data included age, sex, and whether living alone or living in nursing home or other institutions. Clinical data included co-morbidities, smoking status, medications, long-term oxygen therapy (LTOT), blood pressure (mmhg), pulse (heart beats per minute), results of blood test including arterial blood gas, description of chest x-ray and others. The administrative data included length of stay (LOS) in days, day of week of admission,

discharge department (pulmonary medicine, endocrinology, gastroenterology, geriatrics, haematology, infectious diseases or an observation unit connected to the emergency unit), number of admissions due to acute exacerbation of COPD during 12 months before and 12 months after the index admission, or to the date of death, if applicable.

Spirometry

The following spirometrical value closest in time to the index admission was extracted: forced vital capacity (FVC), forced expiratory volume in 1 s (FEV₁) and FEV₁/FVC. Body weight and height were recorded, and body mass index (BMI), defined as weight in kilograms divided by the square of height in meters, was calculated. FVC and FEV₁ values are expressed in litres and as a percent of predicted using the Gulsvik standard.¹³¹

Laboratory results and chest radiograph

In addition, the results of all laboratory analyses sampled in the emergency room on admission were retrieved from the hospital's laboratory database. The following results were registered: haemoglobin concentrations (g/dl), white blood cell count ($\times 10^9$ /l), serum C-reactive protein (mg/l), serum creatinin (umol/l), serum glucose (mmol/l), serum total protein level (g/l) and serum albumin level (g/l). The values of arterial blood gases sampled in the emergency room were also registered. All the descriptions of chest radiographs were manually reviewed and categorized as whether or not there were infiltrates consistent with pneumonia.

Co-morbidities

The following major co-morbidities were registered: ischemic heart disease, cardiac arrhythmias, congestive heart failure, cor pulmonale or pulmonary hypertension, psychiatric disorder; general atherosclerosis, cerebral insult, diabetes mellitus, neurologic disorders other than cerebral insult, any malignancy ever, osteoporosis, kidney failure, or abuse of drugs or alcohol.

3.1.3 Organization of different departments

The staff of the Pulmonary Department at Aker Hospital consists of pulmonologists, residents, nurses and a physiotherapist. The residents rotated between the different departments within the internal medicine department every 6 months as part of a specialization program in internal medicine. Other staff in the Pulmonary Department worked

on a more permanent basis. The residents, under the supervision of pulmonologists, carried out the rounds and decided on treatments, discharge planning and follow-up.

The other medicine departments were organized in a similar way, except that the senior physicians had internal medicine sub-specialities other than pulmonary medicine. Patients in need of non-invasive ventilation (NIV) were centralized to an intensive care unit, and the criteria for use of NIV was defined in line with international guideline.⁵

3.1.4 Self-management program

In the Pulmonary Department unit, the staff had designed a self-management program aimed at reducing COPD-related readmissions. This program included five steps as follows: (1) Group education regarding different aspects of COPD directed to the patients and their family caregivers; (2) Individual review of a self-management program for the early treatment of new episodes of AECOPD; (3) Strengthening the contact with the patients' general practitioners at discharge; (4) Mediation of assistance from the primary healthcare provider when needed; (5) Assessment of the need for and possible referral to pulmonary rehabilitation.

This self-management program was offered only to the patients in the Pulmonary Department on an informal basis, the participation in the program was not systematically registered.

The quantitative study was accepted by the local Privacy Ombudsman for Clinical Research at Oslo University Hospital (2011/12102). The Regional Committee for Medical Research Ethics in South-East Norway advised that approval for the study from them was not necessary (S-09079d, 2009/123).

3.1.5 Data analyses

Since detailed descriptions of methods have been presented in the respective papers, we only describe the respective statistic methods briefly here.

In the quantitative study, missing values for FEV₁, BMI, serum albumin and the partial carbon dioxide tension in arterial blood (PaCO₂) were imputed from the other known variables using multiple linear regression analysis. Patients with missing values after this procedure were excluded from the final analysis.

We defined long length of stay (LOS) as LOS > 75th percentile (11 days). Both univariate and multivariate logistic regression analyses had been done. The multivariable analysis initially included variables with $p \leq 0.25$ in the univariate analysis. Variables were then manually removed one by one while watching changes in the coefficients in order to arrive at a final parsimonious model. In order to evaluate the performance of the predicting model Receiver operating characteristic (ROC) analysis was performed and area under the ROC curve was calculated.

In order to select comparable patients discharged from Pulmonary Department and other medicine departments, the propensity score to each patient was calculated and used to match patient on the 1:1 basis. A propensity score is the statistical chance a patient has of having an exposure given the observed variables.¹³² The propensity score in this study was the probability for a patient being discharged from the Pulmonary Department, as predicted using a logistic regression model. The matching was based on the predicted log odds ratio of the propensity score. After matching process, we got two comparable patients who were actually discharged from Pulmonary Department and other medicine departments. Then COPD-related readmissions within 12 months after discharge between these two patient groups were compared using paired *t*-test. The readmission rate was further adjusted for those who died before the end of the 12-month follow-up period.

In all the analyses, the level of statistical significance was set at $p < 0.05$. Stata software (version 10.1) was used for all statistical analyses and *psmatch2* procedure for pairwise matching in paper II (Stata Corp, College Station, TX, USA).

3.2 The qualitative study (paper III)

Material in the qualitative study consists of semi-structured interviews of nine patients who had been recruited through a randomized and controlled trial (RCT) investigating long-term effects of a HaH programme (ISRCTN 36101176).

3.2.1 Hospital at home programme

After years of planning, the RCT started to include patients in autumn in 2008. Main inclusion criteria were that the patients were considered to have acute exacerbation of COPD and needed hospital admission. The main exclusion criteria were life threatening respiratory

failure, confusion or not being able to give written consent, impaired consciousness and changes in chest x-ray or co-morbidities in need of further inpatient investigation or treatment. Patients were allocated to HaH or continued hospital treatment within 36 hours after the primary evaluation of patients at the emergency room. The RCT experienced a slow inclusion rate and was terminated after a year because of this. At this point 12 patients were included.

Patients randomized to home treatment (HaH patients) were visited by a specialised hospital nurse once a day in a period of three days. The visit lasted up to one hour depending on the needs. The nurse evaluated the patients' clinical status and essential clinical parameters, obtained blood samples for later analysis when needed, and assessed whether or not the patients could still be treated at home. The nurse could consult a pulmonologist in case of worsening of the patients' symptoms. After the consultation, decisions were made on frequency of follow-up, therapy changes or readmission to the hospital. Furthermore, the nurse invited the patient and his/her spouse to a dialogue, e.g. she asked how the patient felt and encouraged them to reflect on possible causes of the acute exacerbation and how to prevent it. During the three-day period the patients could call the hospital at any time if they were concerned about their condition, especially regarding indications for readmission. Inpatients were treated according to ordinary hospital routines. Both patient groups were during the subsequent year offered three outpatient follow-up consultations with a pulmonologist in the hospital. The first visit was approximately six weeks after discharge.

3.2.2 Study sample

All 12 patients recruited to the RCT were considered eligible. After excluding three patients because their medical condition had worsened, all of whom had received in-hospital treatment, nine patients were included. Six patients received HaH treatment (HaH patients) and three received traditional hospital treatment (inpatients). The patients varied in age from 50-80 years old, sex, civil status, (previous) occupations, co-morbidities, and COPD history including earlier COPD-related hospital admissions. The inpatients were interviewed in order to see the HaH patients' experiences in light of traditional hospital care.

Written informed consent was obtained from all participants, and the study was approved by the Regional Committee for Medical Research Ethics, South-East Norway (08-158-07292b 1.2007.2613).

3.2.3 Data collection

The empirical data in paper III consists of transcriptions of semi-structured audio-taped in-depth interview of nine patients based on Kvale's principles.¹³³ This means that the researcher had prepared interview guides for the two informant groups (HaH patients and inpatients) before the interview (appendix), but the guides were used flexibly. This implied that all the questions in the guide were asked, but different topics could be explored more deeply in different interviews and new topics could be brought up by the informants during the interviews. The researcher could follow up this with further questions in order to get more information about the new topics. The interview guides in this qualitative study included questions about the patients' experiences and their benefit of the treatment programme.

The interviews were carried out in the patients' home between seven and ten weeks after hospital discharge, except for one interview that was conducted in the outpatient clinic. The interviews lasted between 60 and 90 minutes with the HaH patients, and 30 minutes with the inpatients. Four spouses (three of the HaH patients and one of the inpatients) were present and participated in varying degree in the interviews.

3.2.4 Data analysis: systematic text condensing

The analysis was carried out in collaboration with the supervisors and according to a systematic text condensing method. This method is elaborated on Giorgi's psychological phenomenological analysis principles and includes the following four steps alternating between the various steps throughout the entire process as described by Malterud: (1) Reading through the whole material to obtain an overall impression; (2) Identifying themes representing different aspects of the patients' experiences and coding these under different thematic headings (i.e. coding groups). The coding groups "feeling safe," "individually adapted information," and "managing strategies" were developed; (3) Abstracting and condensing the content within each coding group; and (4) Summarising the content within each thematic heading. Suitable quotations were chosen to illustrate the findings.^{134,135}

The analysis focused on the patients' experiences of the HaH programme, and whether the patients had obtained something from the programme that helped them to manage their chronic illness in everyday life. This was seen in light of the inpatients' experiences of traditional hospital care.

4 Summary of results

Paper I: Factors associated with a long hospital stay in patients with acute exacerbation of COPD

In this paper, we started with 599 patients who had been admitted for acute exacerbation of COPD. Nine were excluded from the further analysis because of missing data after data imputation of albumin, PaCO₂ and FEV₁. The average age of the final population with 590 patients was 73.2 ±10.8 years (mean±SD). Of them 54% were women. Mean length of stay (LOS) was 8.9±9.7 days, with a median of 6.0 days (interquartile range 3.5–11.0). Mean serum albumin level (g/l) was 38.8±4.6; mean PaCO₂ (kPa) was 5.9±1.6; mean FEV₁(l/s) was 1.0 ±0.50. There were 42 (7%) patients who had long-term oxygen therapy and 498 (84%) patients had at least one co-morbidity. Number of patients admitted on Thursday-Saturday was 237.

In univariate analysis, FEV₁, COPD-related admission during the previous 12 months before the current admission, admission during Thursday-Saturday, having at least one co-morbidity, high PaCO₂ and low serum albumin level were significantly associated with a LOS longer than 11 days ($p<0.05$, Table 2). In multivariate analysis, only admission during Thursday-Saturday, having co-morbidity, high PaCO₂ and low serum albumin level were independently associated with a long LOS (Table 3). Admission during Thursday-Saturday increased the odds ratio (OR) of a LOS longer than 11 days to 2.24 [95% confidence interval (CI) 1.60–3.51]. The OR for the presence of co-morbidity compared with no co-morbidity was 2.08 (95% CI 1.08–4.02). An increase of 1 kPa in PaCO₂ had an OR of 1.26 (95% CI 1.13–1.41), and an increasing serum albumin level was associated with a shorter LOS (OR 0.92 [95% CI 0.87–0.97]). The area under the ROC curve was 0.70, which means a less satisfactory predictability.

Paper II: Readmissions for COPD: propensity case-matched comparison between pulmonary and non-pulmonary departments

In this paper, we started with a population of 566 patients who were discharged alive after the index admission for acute exacerbation of COPD. Of them, 85 were excluded because of missing data after the data imputation of FEV₁ and BMI. Of those 481 available for analysis, 247 were discharged from the Pulmonary Department and 234 from other medicine

departments. The matching process resulted in 155 matched pairs which did not differ significantly from each other concerning covariates, and these patients were used for analysis of COPD-related readmissions.

The readmission rate was 0.8 (SD 1.3) per year per patient discharged from the Pulmonary Department and 1.1 (1.9) for those discharged from other medicine departments ($p=0.09$). There was a tendency for the readmission rate to be lower among those discharged from the Pulmonary Department. Since some of the patients died during the 12 months follow-up period, and therefore contributed to false low readmission rate, we made adjusting for exposure time by annualization at individual level. After this procedure, the respective readmission rate per patients per year was 1.1 (2.3) and 1.6 (4.0) ($p=0.17$) for patients discharged from Pulmonary Department and other medicine departments.

In the negative binomial regression analysis, the incidence rate ratio for readmission during the subsequent 12 months for patients discharged from the Pulmonary Department versus patients discharged from the other medicine departments adjusted for exposure time was 0.71 (95% confidence interval 0.47–1.06; $p=0.09$).

Paper III: Patients with acute exacerbation of chronic obstructive pulmonary disease feel safe when treated at home: a qualitative study

Semi-structured interviews were carried out with six patients who received hospital at home (HaH) treatment programme and three patients received traditional hospital care. The interviews lasted between 60 and 90 minutes with the HaH patients, and 30 minutes with the inpatients. Four spouses (three of the HaH patients and one of the inpatients) were present and participated in varying degree.

The most important finding was that patients who received HaH treatment programme and their family caregivers felt safe during the treatment period of 3 days despite the limited help they got from the hospital. Several elements have been pointed out by the patients as contributing factors of their feeling of safe. Firstly, the adapted and individualized information made them feel in “safe hands”. The knowledge of COPD and its impact, how to handle symptoms in daily life as well as correct use of drugs, different types of inhalation devices and medical equipments was high valued. Different patients struggled with different problems in their daily life, and the information, according to the patients, was directed to

their personal concerns and thus easier to remember. Secondly, the framework of the Hospital at Home programme made patients feel safe. The possibility of telephone consultation with the pulmonary department and instant readmission when needed was important. The competence and stability of the health personnel and the predictability of the home visit helped reassure patients. The time frame of the home visit—up to one hour daily—gave patients an opportunity to ask questions and discuss solutions for big and/or small challenges in their everyday lives. The familiar home environment created a unique opportunity to remind patients about how they used to struggle in their daily lives. Another finding related to the individual information was the positive impact on the patients' self-management of COPD by applying the new knowledge they gained from the HaH programme.

The safety issue for patients receiving traditionally hospital care is a certainty. However, they did not receive information other than the relevant results of investigations done in the hospital.

5 General discussion

5.1 *Methodological considerations*

5.1.1 Overall study design

Both quantitative and qualitative methods were chosen for this study, based on our research questions. In general, the quantitative method using statistical or mathematical techniques is suitable to compare differences, predict outcomes, and discover correlations or frequencies and test a hypothesis. The empirical material consists of numbers. In this study, we chose a retrospective design for the quantitative study because it is less time consuming and cheaper than a prospective study. The main drawback was missing data which we cannot control.

In the quantitative studies, parameters and outcomes such as age, sex, co-morbidities, readmission rate, and length of stay (LOS) are clearly defined. The hypothesis was established before the data was collected, i.e. patients discharged from the Pulmonary Department had lower readmission rate than the comparable patients discharged from other medicine departments. Our goal was to test this hypothesis and association between collected variables and long LOS. Therefore a quantitative method was suitable.¹³⁶

Qualitative research methods were developed within the social and human sciences; they refer to theories on interpretation (hermeneutics) and human experiences (phenomenology).¹³⁶ The notion “qualitative” refers to the quality, characteristic, hallmarks or nature of phenomenon under study. The qualitative research method is suitable to investigate the meaning of social phenomena as experienced by the people themselves.¹³⁷ Qualitative methods are also useful to the study of thoughts, expectations, meaning, attitudes and processes, especially related to interaction, relations, and interpretation—all core components of clinical knowledge.¹³⁶ The third research question in this study was to explore the patients’ experiences of a Hospital at Home programme; therefore a qualitative method was suitable.

A qualitative design uses various strategies for systematic collection, organisation, and interpretation of textual material obtained by talking with people or through observation. The ultimate goal is understanding the phenomenon studied and identifying new questions rather than definite answers.¹³⁵ These methods are increasingly recognized in medicine and public health research.¹³⁸ The empirical material consists of texts and results aims to describe the

phenomena studied or generate a new conception or theory. In the research process, the researcher plays an active role in the development of knowledge. In our qualitative study, we chose to talk with patients by interviewing them to obtain data.

In summary, the character of the research question decided the choice of research method.

5.1.2 The quantitative studies (paper I and II)

5.1.2.1 Sample selection and data collection

This is a retrospective study, and the selection of patients was based on the discharge diagnoses. This made us depend on the practice of the clinicians. We decided to accept the diagnoses made as they were and not change them, although we could see that the diagnoses of a small minority of patients with available spirometry value were not correct according to the GOLD definition.⁵ However, we excluded the patients with inconsistent diagnoses over time; for example, the same patient got asthma (J45) and COPD in different hospital admissions. The percentage of missing spirometry values was comparable with another study, indicating that the quality of data does not differ largely in similar populations.¹³⁹ Although some patients might be labelled with COPD without spirometry confirmation, we included these patients, too, since these patients were treated as if they had COPD.

Every medical record of index admission and the readmissions of included patients were manually reviewed and searched for variables we planned to collect. Though the process was time consuming, we got more accurate and detailed data than data based on administrative data only. We had no control of the blood samples ordered, parameters measured or missing data. Compared to a prospective design in which all variables are systematically collected for every patient, this is an obvious drawback. In order to reduce the uncertainty of missing data, we imputed what we considered important variables such as FEV₁, albumin and PCO₂, as described in the method. This imputation also contributed to avoid excluding patients with missing of these data, which would have reduced the statistical power of the studies. Patients with missing data after the data imputation were excluded.

There were few missing values for laboratory tests. This might be because at Aker hospital, there was a general “basic package” of blood samples taken in the emergency room for all patients that referred for assessment of hospital admission in the Internal Medicine Division;

therefore there was little difference between patients concerning the blood samples analyzed. We considered the overall data quality of this real world study was good.

The study population was recruited from a single university hospital in Oslo, and it might not represent other regions. However, the population included was relatively large and was unselected because all patients with a discharge diagnosis of COPD were included. Furthermore, both the age and LOS in our study were comparable to those in other, larger studies, which support the representativeness of our sample.^{83,140}

However, the population was smaller after the matching process in paper II. A post hoc power calculation showed that a sample size of 310 patients enabled us to detect differences in readmission rates of 0.32 SD, with 80% power and $\alpha=5\%$. This could be classified as a small-to-medium effect size on the scale of Cohen's d, where 0.2 is defined as a small, 0.5 a medium and 0.8 as a large effect size.¹⁴¹ We might have increased the sample size by relaxing the criteria for matching. However, this would have reduced the comparability of the patient groups and led to a more biased result. Despite the limited power, our result is consistent with those of larger observational studies using different study designs and methods.^{83,84}

5.1.2.2 Management in different departments

The method section described the organization and daily activity in the different departments. The major challenge in paper II was that we did not have detailed information about the possible differences in treatment and patient management between the two patient groups. The self-management programme was offered only to patients discharged from the Pulmonary Department. Originally, we aimed to analyse the effect of the self-management program, since the programme, although brief, included patient education and a self-management plan that, together with other interventions might reduce the readmission rate.^{117,118} Consequently, some of the patients discharged from the Pulmonary Department might have been more able to manage a new COPD exacerbation and possibly prevent readmissions, e.g. the programme would rather inflate than deflate the difference in readmission rates between the Pulmonary Department and the other medicine departments. However, the identity and number of patients who participated in the self-management program were not systematically registered despite the standardized template for discharge report. We realized that the assessment of the programme's effect on readmission was impossible and instead, we decided to assess the overall effect of discharge from Pulmonary Department versus other medicine departments.

As reported by a study from UK, more respiratory consultants and related staff reduces the length of stay and in-hospital mortality of the exacerbated COPD patients.⁸³ Therefore we wanted to assess whether better accessibility to pulmonologists would result in a reduced readmission rate.

We are not aware of other variables we could use to describe the difference in medical practices between the Pulmonary Department and the other medicine departments. We have included the available variables in the propensity score. However, there might be important unobserved variables that we cannot take into account.

5.1.2.3 Data analyses

Annulization of readmission rate at individual level

We decided to annualize the COPD related readmission rate for each patient because a considerable number of patients died during the subsequent 12 months of the follow up period; therefore some patients might have fewer readmissions than if the patients were alive. After annualization, the differences in the readmission rate was mathematically increased from 0.3 to 0.5 between the departments, but at the same time the p-value also increased from 0.09 to 0.17, or the statistical differences in the readmission rate were decreased. Because of differences in time “at risk” if patients died within the first year, we think it is reasonable to adjust for the actual observation time by annualization.

Propensity score method

The propensity score method employs a balancing score that aims to correct bias in patient selection by creating equivalent risk groups for analysis. The propensity score method is well accepted and widely used in observational studies in medicine.^{142,143} Compared to conventional modelling approaches, this method reduces the bias of estimates by balancing the background characteristics and thus more reliable selection of comparable populations in observational studies.¹⁴⁴ The propensity score in paper II was the probability of a patient being discharged from the Pulmonary Department, as predicted using a logistic regression model. The selection of variables for the model was based on the assumption that all available factors that could influence the clinician deciding where to allocate patients should be included. Since over-fitting of propensity score models are not a problem, we allowed the final model to include many covariates.¹⁴⁵ An unadjusted comparison of patients discharged

from the Pulmonary Department and other internal medicine departments showed a significant difference in length of stay, number of patients using inhaled corticosteroids and long-acting β_2 -agonist and the proportion of patients receiving non-invasive ventilation. After applying the propensity score model, however, the differences were no longer statistically significant. We believed that this procedure enabled us to select comparable patients discharged from Pulmonary Department and other medicine departments and ensured the comparison of readmission rate between these two patients groups was fair. Although there are obvious advantages with this model, we have to remember that the propensity score model does not adjust for unknown confounders. Furthermore, the inclusion of unobserved or unmeasured covariates in the model may, instead of correcting overt bias, introduce bias.¹⁴⁶ Therefore, the proper application of the propensity score method is essential to benefit from the advantages of the method.

5.1.3 The qualitative study (paper III)

As Malterud points out, whether qualitative methods are scientific research methods depends on systematic collection, organization and interpretation of textual material obtained from talk or observation.¹³⁶ She also proposed that relevance, validity, and reflexivity are overall standards for qualitative studies.

5.1.3.1 Study sample

The study sample consisted of six home patients and three inpatients varied in age, sex, marital status, earlier professions, earlier history of hospitalization for COPD and earlier participation in a pulmonary rehabilitation programme. Three spouses participated in the interviews and complemented information about what happened during the home treatment period. During the interviews, two female spouses gave a more detailed description of emotional reactions during the home treatment period and told that they also helped male informants remember practicing the advice from the visiting nurse after the home treatment period. Although six informants are not a lot, it is not unusual in qualitative studies to have a few informants.¹⁴⁷

5.1.3.2 Data collection

In this qualitative study, semi-structured in-depth interviews were carried out to collect the empirical data. The interviews were audio-taped and transcribed word by word right after the

interview by my self. I also wrote down my immediate impression of the interview and the observation obtained from the informants' home. This was done in order to better understand the context for the informants' experiences. Although the transcription process was time consuming, it gave me a good opportunity to evaluate my interview technique and role during the interview and a chance to improve my interview techniques. Since Norwegian is not my native language, I was particularly aware if there were any expressions or nuances of the language I did not know. In order to avoid misunderstanding, I repeated the sentences or came up with a confirming sentence such as, "You mean ...", when I was not sure about what had been said, or I just asked the informants whether I had understood correctly. This strategy is also in accordance with accommodation within literature about qualitative methods.¹³³

The flexibility of the interview allowed both informants and their family carers to come up with new topics and give detailed description about their experiences and feelings. The open-ended questions enabled informants to describe their experiences in their own way without feeling that this might not be "correct." Some informants were richer in words than others, and different informants emphasized different topics depending on what made the most impression during the home treatment period.

The patient inclusion was done by the clinicians at the Pulmonary Department and the home visits carried out by the specialized nurse. I recruited the informants at the 6-week follow-up myself. The informants knew I am a physician and working with this project. I emphasized that I interviewed them as a researcher and would like to hear about the negative experiences of the home treatment programme. Of course, my profession as a physician who is trained to conclude and make diagnosis as the conversation continues, could mean I took a more leading role than desired during the interview. My supervisor reminded me of the importance of asking open-ended questions, especially about the negative experiences of the treatment programme. It seemed that the patients felt free to talk and I got information about both positive and negative experiences of the programme during the interviews and we got a good variety of experiences.

The home environment also may have enriched the interviews in the way that informants remember more details from the home treatment period. They even used the furniture to demonstrate how and what the nurse told them to do. Also, it appeared natural for the family

caregivers to participate in the interviews and supply with valuable information. One interview was carried out at the outpatient clinic and it was shorter than others. The patient had gone through several examinations and was anxious about getting home, thus some information might have been missed.

All the informants were interviewed about 6 weeks after they received home treatment programme. Some of the informants had difficulties remembering details of what happened during the 3 days home treatment period. Earlier interview might reduce this problem.

5.1.3.3 Analysis method

The interview transcriptions were analysed according to a method of systematic text condensation.¹³⁵ The analysis was done in cooperation with my supervisors. After several code processes, the coding groups “feeling safe,” “individually adapted information,” and “managing strategies” were developed. With this method, we summarized the contents across the informants and therefore lost the opportunity to get more detailed information from each single informant. Although their life stories could help us better understand the background for their perception of the treatment programme, we were more interested in the informants’ experiences with the programme.

5.1.3.4 Validity

With internal validity, we ask what it is true about.¹³⁴ An accepted theoretical principle when using qualitative methods is that many different version of reality exist, and they can be valid simultaneously.¹³⁶ We will never know exactly what happened; only what patients perceived during the 3 days’ home treatment period. In other words, we only see events through the eyes of the patients.

The data in this qualitative study was systematically collected by semi-structured interviews and then transcribed and analyzed by a text condensation method. The results were a description of the informants’ experiences with the Hospital at Home treatment programme, e.g. what the study was intended to investigate, and thus the internal validity was good.

According to Malterud, the nature and extent of the data will ascertain which conclusions can be drawn about external validity.¹³⁴ External validity asks in what contexts the findings can be applied.

The most important finding of the qualitative study is that the patients treated at home felt safe during the home treatment period of three days. The adapted individualized information, the availability of help by telephone and possibilities to be readmitted at any time in the treatment period contributed to the patients' safety. Giving the nature of exacerbation symptoms such as increased breathlessness, which could be life-threatening, in combination with the frequent co-morbid condition of anxiety, we were surprised that the safety issue is not mentioned more in the literature.

Monnikhof described in their study the feeling of safety as "an interesting finding which appeared to be very important for the patients."¹²⁸ The patients in their study, which were not hospitalized for COPD, participated in a much more comprehensive trial that included a self-management education course and fitness programme that lasted more than 2 years, related their feeling of safety to several components, including frequent follow-up, 24 hour-access to the hospital and low barriers to seeking help. Our patients with acute exacerbation and treated at home with limited help in only three days also pointed out the same feeling, illustrating that the importance of safety for COPD patients is a more general concern.

The fact that information contributes to the patients' feeling of safety is not unique in a COPD context. Qualitative studies about patients with severe congestive heart failure (CHF), a similar patient group with high mortality and similar symptoms like breathlessness, anxiety and limited function level, also reported similar findings.^{148,149} Harding et al. reported that "being uninformed about CHF contributed to the patients' anxiety."¹⁵⁰ Selman et al. reported that "the silence around end-of-life issues was a source of fear and anxiety for both patients and carers."¹⁵¹ This corresponds with our finding that information may contribute to the feeling of safety.

5.1.3.5 Reflexivity

Reflexivity is another important aspect of qualitative methods. Malterud describes reflexivity as "an attitude of attending systematically to the context of knowledge construction, especially to the effect of the researcher, at every step of the research process."¹³⁴ Therefore,

researchers should make it clear for both themselves and readers how their own preconceptions may affect the results of a study.

For me, growing up in a different culture with a different approach to interpersonal relationships and the doctor-patient relationship, the qualitative study brought me into a different world. I learned to see things from a different angle and it helped me understand how patients and their family caregivers experienced the treatment programme. The home environment made deep impression on me. To see with my own eyes the informants' struggles with their daily lives, the worries of the family caregivers, and the psychological distress COPD brought, made me reflect about my own practice as physician. It was great to see that despite of their personal problems, the informants were positive about the treatment programme and grateful for the help they got. I believe the qualitative research process will help me to communicate better with the patients, take patients' view into consideration and mediate my clinical message in a more realistic and understanding way. I hope this can in turn contribute to improved adherences of the patients.

5.2 Discussion of results

5.2.1 Length of hospital stay

This study assessed two clinical outcomes of COPD exacerbation, length of stay (LOS) and COPD-related readmission rate. We found that partial pressure of carbon dioxide in the arterial blood, serum albumin level, co-morbidity and admission on Thursday-Saturday were associated with LOS. Patients admitted for COPD exacerbation and discharged from the Pulmonary Department did not have a lower readmission rate than comparable patients discharged from other internal medicine departments during 12 months of follow-up after discharge. We also explored patients' experiences of a Hospital at Home treatment program (HaH) of the acute exacerbation of COPD. We found that patients receiving home treatment (home patients) for COPD exacerbation felt safe and appreciated the individualized information that helped them manage COPD in their daily lives.

Currently there is not established standard for LOS in COPD exacerbation. This might be due to the heterogeneity of patients admitted and the complexity of the disease. Over the past two decades, the trend of LOS has decreased internationally.^{59,63,152} Despite this reduction, the most commonly reported mean or median LOS is still 6-10 days, and thus, more than the “necessary” 6 days as indicated by Mushlin et al. in 1991.^{67,70,83,140} Neither pharmacological improvement over the past decades, application of non-invasive ventilation treatment, nor the development of new forms of health services such as HaH and other forms of integrated care reduced LOS so much that it is shorter than the “necessary” LOS suggested more than 20 years ago.

There might be several explanations for the relatively long LOS in COPD, and both patient- and non-patient factors are involved. Considerably more efforts have been made to identify patient-related factors than non-patient related factors. Among patient-related factors, both demographic and clinical variables have been reported; for example, age, sex, living alone, requirement of social work during hospital admission, and residence in socioeconomic deprived area.^{63,67,69,73,74} Among clinical variables, lung function, blood pressure, arterial blood gas value, acute lower respiratory infection, co-morbidities, number and type of drugs used on admission, severity of dyspnoea and performance status have been reported.^{62,67,69,70,73,83,153} Most of these factors reflect the overall health condition of the

patients and the severity of COPD and are therefore not amenable for interventions, especially interventions during a short period of hospital stay. Thus it makes sense that only 8% of inter-hospital and 12% of inter-patient variations of LOS could be explained by the patient-related factors.^{73,154} In contrast to the extensive research on patient-related factors, much fewer non-patient-related factors have been explored. Price et al. found that the organization and resources of health care services may influence LOS in the way that an increased number of respiratory consultants was associated with shorter LOS.⁸³ Also the application of a clinical pathway may reduce LOS.¹⁵⁵

Our results in the median LOS (6 days) and LOS-related patient factors (co-morbidities, PaCO₂ and serum albumin level) are in line with published studies.^{67,70,83} However, admission day of week, which is a non-patient related factor, is seldom commented upon in the COPD literature. A Spanish study documented the association between prolonged LOS and weekend admission for COPD (Friday-Sunday) where long LOS was defined as more than 3 days.⁶⁹ Another study from Singapore studied the impact of admission on the weekend and public holidays not only for COPD but also other diseases, and found prolonged LOS for patients hospitalized in these days.¹⁵⁶ The authors of the respective articles suggested that the reason for prolonged LOS might be due to the reduction and discontinuity of the medical staff, which is an organizational question. Since only a minor percent of differences in LOS between hospitals could be explained by patient-related factors, non-patient related factors such as organizational factors may play a more important role than we are aware of.⁷³ Price et al. commented their results that increased number of respiratory consultant were related to lower mortality and shorter LOS as the effect of “something about the whole unit with a higher number of respiratory consultant staff” and “not necessarily the individual care offered by each single consultant” without further comments what this “something” could be.

One of the results of our qualitative study indicated that this “something” might be competence among health professionals and/or the way patients were treated, which made patients feel “safe” and “in good hands.” The process creating this safe feeling may in turn be reflected in reduced mortality and shorter LOS. Mushlin et al. commented in their article that one reason why the actual LOS was longer than medically necessary was that the physicians wanted to observe patients another day to be sure the patients could manage themselves at home after discharge.⁷⁰ If the physicians knew the patients would be taken care of after discharge, they might not keep these patients in the hospital an extra day, as was case in our

qualitative study where patients were discharged after 1.5 days of hospital stay and were followed up by a respiratory nurse in the following 3 days after hospital discharge. Their hospital stay was very short compared to the common average LOS. However, the home patients in our qualitative study explicitly expressed that they felt safe because of the competence of the visiting nurse and the trust established between them. They also mentioned that knowing they could call the nurse/hospital at any time during the follow-up time made them feel “taken care of.” Therefore the easy availability of good quality health services may contribute to their feeling of safety and influence LOS, as indicated by Agdoabo et al., who found it more likely to discharge patients within a shorter distance to the hospital than otherwise.⁶⁷ This might be because health care is more available in areas near the hospital and the threshold of discharge could be lower. It is understandable that safety is the patients’ major concern—how can we ensure it should be the major concern of the health care system, too.

There are indications that adequate LOS may contribute to patients’ safety and, for some patients, it is medically necessary to be hospitalized longer than others. Saynajakangas et al., after assessing more than 72,000 COPD hospitalizations, concluded that LOS of 7 days gave the longest interval to the subsequent hospitalization for COPD.⁶³ They also found that LOS shorter and longer than 7 days was associated with shorter interval for subsequent COPD-related readmissions. Considering the many negative effects of hospitalization on patients, our treatment goal should be prolonging the interval between hospitalizations. The results of a Canadian study based on a large COPD population clearly pointed out that patients were at highest risk of death within the first 7 days of hospitalization for acute exacerbation and thus special attention should be paid in this period.¹⁵⁷ Therefore, LOS should be determined by the patients’ medical condition and not overcrowded hospitals, in spite of the health authority’s expectations of “treat more by less.”⁶⁵

5.2.2 COPD-related readmission

After hospital discharge, many patients will be readmitted for COPD, and for some of them, in a relatively short time. History of hospitalization for COPD is the best single predictor of readmission.⁵⁷ Furthermore, exacerbations tend to cluster in time and increase the risk of readmission in this period.¹⁵⁸ According to Suissa et al., the risk of the next severe exacerbation requiring hospital admission peaks during the trimester after discharge, and the median time between successive severe exacerbation decreases with every new severe

exacerbation, from around 5.4 years from the first to second (given the patient not died) to less than 4 months from the 9th to the 10th.¹⁵⁷ This is reflected in the high readmission rate, which is up to 60% in the subsequent year after the discharge.^{75,78} High readmission rates evoke concerns, and substantial efforts, mostly after hospital discharge, have been made to reduce them. The literature about interventions carried out while patients are still in hospital is sparse.

In paper II, we compared COPD-related readmission rates during a 12-month follow-up period after an acute COPD exacerbation between patients discharged from a Pulmonary Department with comparable patients discharged from other medicine departments. Some of the patients discharged from the Pulmonary Department received a five-step program, including patient education addressing the recognition of symptoms of exacerbation and an action plan in case of new exacerbations. Unfortunately, their participation was not systematically registered and therefore the effect of this program could not be assessed. We found a non-significant trend of reduced readmission rate in favour of patients discharged from Pulmonary Department. This finding supports previous studies suggesting that COPD-related readmissions are largely unrelated to the inpatient management process.^{73,83,84}

Studies have shown that other factors that can not be expected to be affected by a short hospital stay are important predictors of readmissions. These factors include history of hospitalization for COPD, quality of life, performance status or physical activity level, exposure to environmental tobacco smoking, age, sex and a low FEV1.^{73,75,83,159} Most of these factors reflect the severity of COPD and therefore are not amenable for short interventions such as hospital admission. In agreement with this, most interventions aiming to reduce readmission rates are performed after hospital discharge, e.g. in the community, including extensive patient self-management education, involvement of a multidisciplinary team and years of follow-up.^{117,118} This raises the question of whether it is realistic to reduce readmissions with interventions during the hospital stay.

Probably, it is neither possible nor realistic to reduce the readmission rate for all patients admitted for COPD exacerbation. One randomised controlled trial (RCT) from Glasgow showed that a similar intervention as described earlier aiming at reduction of readmission rate had no effect considering the entire study population, but did affect a younger subpopulation not living alone. Evidence from other similar intervention studies also showed that only a limited subpopulation of hospitalized COPD patients met the inclusion criteria and all studies

experienced difficulties recruiting patients. For example, in the case of HaH, only 25% of screened patients fulfilled the inclusion criteria. In a study reported by Casas et al. that significantly reduced readmission rate, only 19% met the inclusion criteria. It may even be that the natural history of COPD, like the cluster phenomenon of exacerbation, increased frequency of severe exacerbations in advanced disease or simply aged patients, will prevent the reduction of readmission. It has been reported that only 4.7% of readmissions were preventable.¹⁶⁰ Furthermore it might even be dangerous to prevent admissions if these are legitimate. Indeed, a RCT comparing the hospital readmission rate of patients with COPD who had usual care and a comprehensive management program combining education, an action plan for identification, treatment of exacerbations and scheduled telephone calls found that the intervention was associated with unanticipated excess of readmission rate and mortality.¹⁶¹ Therefore, it may be that not all readmissions are preventable and it has been claimed that “hospital readmission rate may not be the most important patient related outcome of health care” and whether an intervention should be implemented should not be only judged by its ability to reduce readmission rate.¹⁶²

5.2.3 Rethinking of traditional health care services

5.2.3.1 Self-management

The positive effect of self-management has been documented.^{79,80} It may even have economic benefits through reduced utilization of health care.¹⁶³ Despite the promising effects, it remains unclear about what aspects of self-management programmes are most effective.¹⁶⁴

Our qualitative study showed that it is important that individualized, adapted information is delivered in a familiar environment (e.g. the patient's home) by competent health professional. Our study showed that concrete and individualized information and advice may be easier to practice in the future. For example, one patient learned to distribute her energy more evenly and another patient learned to use an armchair in the living room to handle the dyspnoea attacks. We also believe that the environment where the information is delivered may influence which information is delivered. For example, the home environment reminded patients in our study about the challenges they met in everyday life and made it easier to remember discussing these challenges with the hospital nurse during the home visit. At the same time, the home environment offers an unique opportunity for health personnel to understand what patients struggled with and made it easier to make a personalized assessment of the concrete situations and offer solutions. To the contrary, the information that the

inpatients got was related mainly to the blood tests and other examinations performed in the hospital, and none of inpatients received other types of COPD-related information. It has been pointed out that one of the reasons the hospital failed to take care of people with chronic disease is the lack of information systems addressing prevention.¹⁶⁵

Furthermore, how and by whom the information is delivered may affect patients' behavior. Home patients in our qualitative study valued the competence of the visiting nurse and the face-to-face contact they and their family caregivers got with the visiting nurse. Such face-to-face contact gave a platform for the patient-centred care that has been shown to have a greater effect than other forms of traditional care such as outpatient clinics.¹⁶⁶ Concrete, individualized information delivered in a familiar environment by competent health personnel may be important to mediating the knowledge of and facilitating behavior changes in patients.

5.2.3.2 Patient's experiences of good health care

Continuity, interpersonal relationships and interaction between health care personnel are other premises of good quality care.¹⁶⁷ The results from our qualitative study gave some examples of how important these factors were for the home patients.

During the home treatment period of 3 days, the patients and their caregivers were visited by the same nurse, which gave them an opportunity to get to know each other. This continuity made a fundament for good interpersonal contact and dialog and mutual trust which made it easier for patients to ask questions. Through conversation and discussion, patients actively involved themselves in the treatment process. Their active involvement in deciding the next home visit time, which may be considered trivial, was one of the contributing factors of feeling safe and controlling the treatment process. Holman and Lorig, after studying arthritis patients, wrote more than 10 years ago that "involving patients in decision-making and treatment planning makes the delivery of care more effective and more efficient."¹⁶⁸

To the contrary, none of the patients receiving hospital care in our qualitative study had the similar experiences of interaction or interpersonal relationship with the health care personnel. The lack of continuity of the staff might have prevented the establishment of interpersonal relationship and the patients' active involvement in their own disease management. It seemed that the patients were used to a passive role created by the system, and they were satisfied and thankful for being "served."

Availability was also important for patients who felt they had been taken care of. The home patients and their caregivers in our qualitative study appreciated the availability of the nurse during the home visit. In one hour, patients and their health problems were the main focus of conversation, especially issues about exacerbation and its prevention. Concrete suggestions were made without interruptions from other patients or routine works. In comparison, the patients receiving conventional hospital care, although staying at hospital 24 hours a day, did not expect the nurses “to sit down and talk a while.” They even showed a great understanding of this since the nurses had a lot of work to do and there were always other patients who needed help more. This form of fast-paced, fast talking health care is a result of the emphasis on expedience for service delivery, which directed nurses’ attention to the management of treatments and pulled them away from relating to patients in a caring way.¹⁶⁹

6 Conclusion

This study evaluated two outcomes related to hospitalization for acute exacerbation of COPD, the predictors of prolonged length of hospital stay and COPD-related readmission rate in patients discharged from pulmonary and non-pulmonary departments. The quantitative data collected from the patients' medical records showed that the admission day of the week, co-morbidities, PaCO₂ and serum albumin level were associated with the LOS. However, we were unable to create a robust predicting model for LOS.

The readmission rates between comparable patients with acute exacerbation of COPD discharged from the Pulmonary Department and other medicine departments for 12 months following an index hospitalization did not differ significantly.

The qualitative data, collected through in-depth interviews with patients who participated a Hospital at Home treatment programme for acute exacerbation of COPD, showed that the patients experienced the home treatment programme as safe. The individualized, adapted information helped patients manage their disease afterward. What patients experienced as important aspects of treatment programme is important knowledge for developing new and effective health services.

7 Implications

The reasons for prolonged length of hospital stay for COPD exacerbation are probably multidimensional. Our findings, together with knowledge from other studies, suggest that non-patient factors such as organizational factors may be as important as patient factors in predicting length of stay, and more researches in this area are needed in the future.

COPD-related readmission remains a challenge to the existing health care system. As Price et al. pointed out in the second UK National COPD Audit “none of the resource or organisational factors accounted for the variation in readmission rate.”⁸³ Readmission rates are seen to be a ‘failure’ by the health service to address the multiple needs of COPD patients. This failure probably reflects the challenge of chronic disease to a system that was constructed to handle acute conditions. The challenge will remain and even become bigger if the health care system does not adapt to the paradigm change, e.g. the transition from communicable disease to chronic disease.¹⁶⁵

According to the World Health Organization’s report, “Innovative Care for Chronic Conditions,” chronic conditions will be responsible for approximately 60% of disease burden worldwide in 2020.¹⁶⁵ The report pointed out several aspects of the existing organization of health care which does not fit the needs of chronically ill patients—failure to address prevention, absence of information system and failure to connect community resource. One Norwegian report also showed that increased fragmentation in the specialist health services creates problems for cooperation within specialist health services and between primary and specialist health services, and this can prevent offering good health care for patients with chronic diseases.¹⁷⁰ The health care system, which is designed for the treatment of acute conditions and treats symptoms when they come, needs to be improved to meet the “multiple needs of COPD patients.”⁸³ To enable COPD patients to take responsibility for daily management, behaviour changes and become the principal caregivers, the health care system needs to give patients knowledge and tools, offer competent support and offer good quality chronic care.¹⁷¹

Patient safety deserves more attention from the health care system. Patients with chronic diseases have different needs that are not satisfactorily met by today’s health care system. The existing health care services should deliver chronic care of good quality and involve patients

in the management of the complex chronic condition. This may benefit both the patients and the health care system.

Qualitative method may help us better understand the results gained from quantitative research and thus deserves more attention in medicine research.

8 References

1. Ciba Guest Symposium. Terminology, Definitions, and Classification of Chronic Pulmonary Emphysema and Related Conditions. *Thorax* 59 A.D.; **14**(4): 286-299.
2. Fletcher CM, Pride NB. Definitions of Emphysema, Chronic Bronchitis, Asthma, and Airflow Obstruction: 25 Years on From the Ciba Symposium. *Thorax* 1984; **39**(2): 81-85.
3. Standards for the Diagnosis and Care of Patients With Chronic Obstructive Pulmonary Disease (COPD) and Asthma. This Official Statement of the American Thoracic Society Was Adopted by the ATS Board of Directors, November 1986. *Am Rev Respir Dis* 1987; **136**(1): 225-244.
4. Pauwels RA, Buist AS, Calverley PM, Jenkins CR, Hurd SS. Global Strategy for the Diagnosis, Management, and Prevention of Chronic Obstructive Pulmonary Disease. NHLBI/WHO Global Initiative for Chronic Obstructive Lung Disease (GOLD) Workshop Summary. *Am J Respir Crit Care Med* 2001; **163**(5): 1256-1276.
5. Global Initiative for Chronic Obstructive Lung Disease (GOLD). Global Strategy for the Diagnosis, Management and Prevention of COPD. 2011. 27-4-2012.
6. Hogg JC. Pathophysiology of Airflow Limitation in Chronic Obstructive Pulmonary Disease. *Lancet* 2004; **364**(9435): 709-721.
7. Rahman I. Oxidative Stress in Pathogenesis of Chronic Obstructive Pulmonary Disease: Cellular and Molecular Mechanisms. *Cell Biochem Biophys* 2005; **43**(1): 167-188.
8. O'Donnell R, Breen D, Wilson S, Djukanovic R. Inflammatory Cells in the Airways in COPD. *Thorax* 2006; **61**(5): 448-454.
9. Cosio MG, Sassetta M, Agusti A. Immunologic Aspects of Chronic Obstructive Pulmonary Disease. *N Engl J Med* 2009; **360**(23): 2445-2454.
10. Fujii T, Hayashi S, Hogg JC, Mukae H, Suwa T, Goto Y, Vincent R, van Eeden SF. Interaction of Alveolar Macrophages and Airway Epithelial Cells Following Exposure to Particulate Matter Produces Mediators That Stimulate the Bone Marrow. *Am J Respir Cell Mol Biol* 2002; **27**(1): 34-41.
11. Salvi S, Blomberg A, Rudell B, Kelly F, Sandstrom T, Holgate ST, Frew A. Acute Inflammatory Responses in the Airways and Peripheral Blood After Short-Term Exposure to Diesel Exhaust in Healthy Human Volunteers. *Am J Respir Crit Care Med* 1999; **159**(3): 702-709.
12. Tan WC, Qiu D, Liam BL, Ng TP, Lee SH, van Eeden SF, D'Yachkova Y, Hogg JC. The Human Bone Marrow Response to Acute Air Pollution Caused by Forest Fires. *Am J Respir Crit Care Med* 2000; **161**(4 Pt 1): 1213-1217.
13. van Eeden SF, Tan WC, Suwa T, Mukae H, Terashima T, Fujii T, Qiu D, Vincent R, Hogg JC. Cytokines Involved in the Systemic Inflammatory Response Induced by Exposure to Particulate Matter Air Pollutants (PM(10)). *Am J Respir Crit Care Med* 2001; **164**(5): 826-830.

14. Barnes PJ. Chronic Obstructive Pulmonary Disease. *N Engl J Med* 2000; **343**(4): 269-280.
15. Dahl M, Tybjaerg-Hansen A, Vestbo J, Lange P, Nordestgaard BG. Elevated Plasma Fibrinogen Associated With Reduced Pulmonary Function and Increased Risk of Chronic Obstructive Pulmonary Disease. *Am J Respir Crit Care Med* 2001; **164**(6): 1008-1011.
16. Fabbri LM, Rabe KF. From COPD to Chronic Systemic Inflammatory Syndrome? *Lancet* 2007; **370**(9589): 797-799.
17. Agusti A, Calverley PM, Celli B, Coxson HO, Edwards LD, Lomas DA, MacNee W, Miller BE, Rennard S, Silverman EK, Tal-Singer R, Wouters E, Yates JC, Vestbo J. Characterisation of COPD Heterogeneity in the ECLIPSE Cohort. *Respir Res* 2010; **11** 122.
18. Barnes PJ, Celli BR. Systemic Manifestations and Comorbidities of COPD. *Eur Respir J* 2009; **33**(5): 1165-1185.
19. Mannino DM, Thorn D, Swensen A, Holguin F. Prevalence and Outcomes of Diabetes, Hypertension and Cardiovascular Disease in COPD. *Eur Respir J* 2008; **32**(4): 962-969.
20. Sin DD, Anthonisen NR, Soriano JB, Agusti AG. Mortality in COPD: Role of Comorbidities. *Eur Respir J* 2006; **28**(6): 1245-1257.
21. Hansell AL, Walk JA, Soriano JB. What Do Chronic Obstructive Pulmonary Disease Patients Die From? A Multiple Cause Coding Analysis. *Eur Respir J* 2003; **22**(5): 809-814.
22. Mannino DM, Watt G, Hole D, Gillis C, Hart C, McConnachie A, Davey SG, Upton M, Hawthorne V, Sin DD, Man SF, Van ES, Mapel DW, Vestbo J. The Natural History of Chronic Obstructive Pulmonary Disease. *Eur Respir J* 2006; **27**(3): 627-643.
23. Mannino DM, Doherty DE, Sonia BA. Global Initiative on Obstructive Lung Disease (GOLD) Classification of Lung Disease and Mortality: Findings From the Atherosclerosis Risk in Communities (ARIC) Study. *Respir Med* 2006; **100**(1): 115-122.
24. McGarvey LP, John M, Anderson JA, Zvarich M, Wise RA. Ascertainment of Cause-Specific Mortality in COPD: Operations of the TORCH Clinical Endpoint Committee. *Thorax* 2007; **62**(5): 411-415.
25. Zielinski J, MacNee W, Wedzicha J, Ambrosino N, Braghiroli A, Dolensky J, Howard P, Gorzelak K, Lahdensuo A, Strom K, Tobiasz M, Weitzenblum E. Causes of Death in Patients With COPD and Chronic Respiratory Failure. *Monaldi Arch Chest Dis* 1997; **52**(1): 43-47.
26. Hynninen KM, Breivte MH, Wiborg AB, Pallesen S, Nordhus IH. Psychological Characteristics of Patients With Chronic Obstructive Pulmonary Disease: a Review. *J Psychosom Res* 2005; **59**(6): 429-443.
27. Omachi TA, Katz PP, Yelin EH, Gregorich SE, Iribarren C, Blanc PD, Eisner MD. Depression and Health-Related Quality of Life in Chronic Obstructive Pulmonary Disease. *Am J Med* 2009; **122**(8): 778-15.

28. Cao Z, Ong KC, Eng P, Tan WC, Ng TP. Frequent Hospital Readmissions for Acute Exacerbation of COPD and Their Associated Factors. *Respirology* 2006; **11**(2): 188-195.
29. Jennings JH, Digiovine B, Obeid D, Frank C. The Association Between Depressive Symptoms and Acute Exacerbations of COPD. *Lung* 2009; **187**(2): 128-135.
30. Ng TP, Niti M, Tan WC, Cao Z, Ong KC, Eng P. Depressive Symptoms and Chronic Obstructive Pulmonary Disease: Effect on Mortality, Hospital Readmission, Symptom Burden, Functional Status, and Quality of Life. *Arch Intern Med* 2007; **167**(1): 60-67.
31. Norwood RJ. A Review of Etiologies of Depression in COPD. *Int J Chron Obstruct Pulmon Dis* 2007; **2**(4): 485-491.
32. Anisman H, Merali Z, Hayley S. Neurotransmitter, Peptide and Cytokine Processes in Relation to Depressive Disorder: Comorbidity Between Depression and Neurodegenerative Disorders. *Prog Neurobiol* 2008; **85**(1): 1-74.
33. Burge PS, Calverley PM, Jones PW, Spencer S, Anderson JA, Maslen TK. Randomised, Double Blind, Placebo Controlled Study of Fluticasone Propionate in Patients With Moderate to Severe Chronic Obstructive Pulmonary Disease: the ISOLDE Trial. *BMJ* 2000; **320**(7245): 1297-1303.
34. Jones PW. Health Status and the Spiral of Decline. *COPD* 2009; **6**(1): 59-63.
35. Rodriguez-Roisin R. Toward a Consensus Definition for COPD Exacerbations. *Chest* 2000; **117**(5 Suppl 2): 398S-401S.
36. Couillard A, Muir JF, Veale D. COPD Recent Findings: Impact on Clinical Practice. *COPD* 2010; **7**(3): 204-213.
37. Rennard SI, Vestbo J. Natural Histories of Chronic Obstructive Pulmonary Disease. *Proc Am Thorac Soc* 2008; **5**(9): 878-883.
38. Calverley PM, Anderson JA, Celli B, Ferguson GT, Jenkins C, Jones PW, Yates JC, Vestbo J. Salmeterol and Fluticasone Propionate and Survival in Chronic Obstructive Pulmonary Disease. *N Engl J Med* 2007; **356**(8): 775-789.
39. Ai-Ping C, Lee KH, Lim TK. In-Hospital and 5-Year Mortality of Patients Treated in the ICU for Acute Exacerbation of COPD: a Retrospective Study. *Chest* 2005; **128**(2): 518-524.
40. Steinmetz J, Rasmussen LS, Nielsen SL. Long-Term Prognosis for Patients With COPD Treated in the Prehospital Setting: Is It Influenced by Hospital Admission? *Chest* 2006; **130**(3): 676-680.
41. Murray CJ, Lopez AD. Alternative Projections of Mortality and Disability by Cause 1990-2020: Global Burden of Disease Study. *Lancet* 1997; **349**(9064): 1498-1504.
42. Halbert RJ, Isonaka S, George D, Iqbal A. Interpreting COPD Prevalence Estimates: What Is the True Burden of Disease? *Chest* 2003; **123**(5): 1684-1692.

43. Johannessen A, Omenaas ER, Bakke PS, Gulsvik A. Implications of Reversibility Testing on Prevalence and Risk Factors for Chronic Obstructive Pulmonary Disease: a Community Study. *Thorax* 2005; **60**(10): 842-847.
44. Johannessen A, Omenaas E, Bakke P, Gulsvik A. Incidence of GOLD-Defined Chronic Obstructive Pulmonary Disease in a General Adult Population. *Int J Tuberc Lung Dis* 2005; **9**(8): 926-932.
45. Murray CJ, Lopez AD. Global Mortality, Disability, and the Contribution of Risk Factors: Global Burden of Disease Study. *Lancet* 1997; **349**(9063): 1436-1442.
46. Mathers CD, Loncar D. Projections of Global Mortality and Burden of Disease From 2002 to 2030. *PLoS Med* 2006; **3**(11): e442.
47. Lopez AD, Shibuya K, Rao C, Mathers CD, Hansell AL, Held LS, Schmid V, Buist S. Chronic Obstructive Pulmonary Disease: Current Burden and Future Projections. *Eur Respir J* 2006; **27**(2): 397-412.
48. European Respiratory Society. *European Lung White Book*; European Respiratory Society Journals, Ltd: Huddersfield, 2003.
49. National Heart LaBI. *Morbidity and Mortality Chartbook on Cardiovascular, Lung and Blood Diseases*; US Department of Health and Human Services, Public Health Services, National Institutes of Health: Bethesda, Maryland, 2009.
50. Nielsen R, Johannessen A, Benediktsdottir B, Gislason T, Buist AS, Gulsvik A, Sullivan SD, Lee TA. Present and Future Costs of COPD in Iceland and Norway: Results From the BOLD Study. *Eur Respir J* 2009; **34**(4): 850-857.
51. Chapman KR, Mannino DM, Soriano JB, Vermeire PA, Buist AS, Thun MJ, Connell C, Jemal A, Lee TA, Miravittles M, Aldington S, Beasley R. Epidemiology and Costs of Chronic Obstructive Pulmonary Disease. *Eur Respir J* 2006; **27**(1): 188-207.
52. Miravittles M, Murio C, Guerrero T, Gisbert R. Costs of Chronic Bronchitis and COPD: a 1-Year Follow-Up Study. *Chest* 2003; **123**(3): 784-791.
53. Halpin DM, Miravittles M. Chronic Obstructive Pulmonary Disease: the Disease and Its Burden to Society. *Proc Am Thorac Soc* 2006; **3**(7): 619-623.
54. Anthonisen NR, Manfreda J, Warren CP, Hershfield ES, Harding GK, Nelson NA. Antibiotic Therapy in Exacerbations of Chronic Obstructive Pulmonary Disease. *Ann Intern Med* 1987; **106**(2): 196-204.
55. Burge S, Wedzicha JA. COPD Exacerbations: Definitions and Classifications. *Eur Respir J Suppl* 2003; **41** 46s-53s.
56. Celli BR, Barnes PJ. Exacerbations of Chronic Obstructive Pulmonary Disease. *Eur Respir J* 2007; **29**(6): 1224-1238.
57. Soler-Cataluna JJ, Martinez-Garcia MA, Roman SP, Salcedo E, Navarro M, Ochando R. Severe Acute Exacerbations and Mortality in Patients With Chronic Obstructive Pulmonary Disease. *Thorax* 2005; **60**(11): 925-931.

58. Jansson SA, Andersson F, Borg S, Ericsson A, Jonsson E, Lundback B. Costs of COPD in Sweden According to Disease Severity. *Chest* 2002; **122**(6): 1994-2002.
59. Sullivan SD, Ramsey SD, Lee TA. The Economic Burden of COPD. *Chest* 2000; **117**(2 Suppl): 5S-9S.
60. Cazzola M, MacNee W, Martinez FJ, Rabe KF, Franciosi LG, Barnes PJ, Brusasco V, Burge PS, Calverley PM, Celli BR, Jones PW, Mahler DA, Make B, Miravittles M, Page CP, Palange P, Parr D, Pistolesi M, Rennard SI, Rutten-van Molken MP, Stockley R, Sullivan SD, Wedzicha JA, Wouters EF. Outcomes for COPD Pharmacological Trials: From Lung Function to Biomarkers. *Eur Respir J* 2008; **31**(2): 416-469.
61. Chang CL, Sullivan GD, Karalus NC, Hancox RJ, McLachlan JD, Mills GD. Audit of Acute Admissions of Chronic Obstructive Pulmonary Disease: Inpatient Management and Outcome. *Intern Med J* 2007; **37**(4): 236-241.
62. Diaz-Peromingo JA, Grandes-Ibanez J, Fandino-Org, Barcala-Villamarin P, Garrido-Sanjuan JA. Predicting Factors Contributing to Length of Stay in Hospitalized Chronic Obstructive Pulmonary Disease (COPD) Patients: the Role of the Emergency Room. *Acta Medica (Hradec Kralove)* 2004; **47**(1): 29-32.
63. Saynajakangas O, Kinnunen T, Tuuponen T, Keistinen T. Length of Stay and Interval to Readmission in Emergency Hospital Treatment of COPD. *Age Ageing* 2004; **33**(6): 567-570.
64. Sin DD, Tu JV. Are Elderly Patients With Obstructive Airway Disease Being Prematurely Discharged? *Am J Respir Crit Care Med* 2000; **161**(5): 1513-1517.
65. Capewell S. The Continuing Rise in Emergency Admissions. *BMJ* 1996; **312**(7037): 991-992.
66. Roche N, Rabbat A, Zureik M, Huchon G. Chronic Obstructive Pulmonary Disease Exacerbations in Emergency Departments: Predictors of Outcome. *Curr Opin Pulm Med* 2010; **16**(2): 112-117.
67. Agboado G, Peters J, Donkin L. Factors Influencing the Length of Hospital Stay Among Patients Resident in Blackpool Admitted With COPD: a Cross-Sectional Study. *BMJ Open* 2012; **2**(5).
68. de II, Valino P, Pita S, Ramos V, Pellicer C, Nicolas R, Diz-Lois F. Factors Predicting a Hospital Stay of Over 3 Days in Patients With Acute Exacerbation of Chronic Obstructive Pulmonary Disease. *J Intern Med* 2002; **251**(6): 500-507.
69. Incalzi RA, Pedone C, Onder G, Pahor M, Carbonin PU. Predicting Length of Stay of Older Patients With Exacerbated Chronic Obstructive Pulmonary Disease. *Aging (Milano)* 2001; **13**(1): 49-57.
70. Mushlin AI, Black ER, Connolly CA, Buonaccorso KM, Eberly SW. The Necessary Length of Hospital Stay for Chronic Pulmonary Disease. *JAMA* 1991; **266**(1): 80-83.
71. Nowinski A, Kaminski D, Korzybski D, Stoklosa A, Gorecka D. [The Impact of Comorbidities on the Length of Hospital Treatment in Patients With Chronic Obstructive Pulmonary Disease]. *Pneumonol Alergol Pol* 2011; **79**(6): 388-396.

72. Parappil A, Depczynski B, Collett P, Marks GB. Effect of Comorbid Diabetes on Length of Stay and Risk of Death in Patients Admitted With Acute Exacerbations of COPD. *Respirology* 2010; **15**(6): 918-922.
73. Roberts CM, Lowe D, Bucknall CE, Ryland I, Kelly Y, Pearson MG. Clinical Audit Indicators of Outcome Following Admission to Hospital With Acute Exacerbation of Chronic Obstructive Pulmonary Disease. *Thorax* 2002; **57**(2): 137-141.
74. Wong AW, Gan WQ, Burns J, Sin DD, van Eeden SF. Acute Exacerbation of Chronic Obstructive Pulmonary Disease: Influence of Social Factors in Determining Length of Hospital Stay and Readmission Rates. *Can Respir J* 2008; **15**(7): 361-364.
75. Garcia-Aymerich J, Farrero E, Felez MA, Izquierdo J, Marrades RM, Anto JM. Risk Factors of Readmission to Hospital for a COPD Exacerbation: a Prospective Study. *Thorax* 2003; **58**(2): 100-105.
76. Garcia-Aymerich J, Monso E, Marrades RM, Escarrabill J, Felez MA, Sunyer J, Anto JM. Risk Factors for Hospitalization for a Chronic Obstructive Pulmonary Disease Exacerbation. EFRAM Study. *Am J Respir Crit Care Med* 2001; **164**(6): 1002-1007.
77. Gudmundsson G, Gislason T, Janson C, Lindberg E, Hallin R, Ulrik CS, Brondum E, Nieminen MM, Aine T, Bakke P. Risk Factors for Rehospitalisation in COPD: Role of Health Status, Anxiety and Depression. *Eur Respir J* 2005; **26**(3): 414-419.
78. Lau AC, Yam LY, Poon E. Hospital Re-Admission in Patients With Acute Exacerbation of Chronic Obstructive Pulmonary Disease. *Respir Med* 2001; **95**(11): 876-884.
79. Adams SG, Smith PK, Allan PF, Anzueto A, Pugh JA, Cornell JE. Systematic Review of the Chronic Care Model in Chronic Obstructive Pulmonary Disease Prevention and Management. *Arch Intern Med* 2007; **167**(6): 551-561.
80. Effing T, Monninkhof EM, van der Valk PD, Zielhuis GA, Walters EH, van der Palen J, Verink M. Self-Management Education for Patients With Chronic Obstructive Pulmonary Disease (Review). *Cochrane Database Syst Rev* 2009; **4**.
81. Lemmens KM, Nieboer AP, Huijsman R. A Systematic Review of Integrated Use of Disease-Management Interventions in Asthma and COPD. *Respir Med* 2009; **103**(5): 670-691.
82. Puhan MA, Gimeno-Santos E, Scharplatz M, Troosters T, Walters EH, Steurer J. Pulmonary Rehabilitation Following Exacerbations of Chronic Obstructive Pulmonary Disease. *Cochrane Database Syst Rev* 2011; (10): CD005305.
83. Price LC, Lowe D, Hosker HS, Anstey K, Pearson MG, Roberts CM. UK National COPD Audit 2003: Impact of Hospital Resources and Organisation of Care on Patient Outcome Following Admission for Acute COPD Exacerbation. *Thorax* 2006; **61**(10): 837-842.
84. Lindenauer PK, Rothberg MB, Pekow PS, Kenwood C, Benjamin EM, Auerbach AD. Outcomes of Care by Hospitalists, General Internists, and Family Physicians. *N Engl J Med* 2007; **357**(25): 2589-2600.

85. Lampela P, Saynajakangas O, Jokelainen J, Keistinen T. Differences in COPD-Related Readmissions to Primary and Secondary Care Hospitals. *Scand J Prim Health Care* 2009; **27**(2): 80-84.
86. Cole MG, McCusker J, Elie M, Dendukuri N, Latimer E, Belzile E. Systematic Detection and Multidisciplinary Care of Depression in Older Medical Inpatients: a Randomized Trial. *CMAJ* 2006; **174**(1): 38-44.
87. Escarrabill J. Discharge Planning and Home Care for End-Stage COPD Patients. *Eur Respir J* 2009; **34**(2): 507-512.
88. Gill TM, Allore HG, Holford TR, Guo Z. Hospitalization, Restricted Activity, and the Development of Disability Among Older Persons. *JAMA* 2004; **292**(17): 2115-2124.
89. Ibanez M, Aguilar JJ, Maderal MA, Prats E, Farrero E, Font A, Escarrabill J. Sexuality in Chronic Respiratory Failure: Coincidences and Divergences Between Patient and Primary Caregiver. *Respir Med* 2001; **95**(12): 975-979.
90. Gudmundsson G, Gislason T, Janson C, Lindberg E, Suppli UC, Brondum E, Nieminen MM, Aine T, Hallin R, Bakke P. Depression, Anxiety and Health Status After Hospitalisation for COPD: a Multicentre Study in the Nordic Countries. *Respir Med* 2006; **100**(1): 87-93.
91. Fraser DD, Kee CC, Minick P. Living With Chronic Obstructive Pulmonary Disease: Insiders' Perspectives. *J Adv Nurs* 2006; **55**(5): 550-558.
92. Pinnock H, Kendall M, Murray SA, Worth A, Levack P, Porter M, MacNee W, Sheikh A. Living and Dying With Severe Chronic Obstructive Pulmonary Disease: Multi-Perspective Longitudinal Qualitative Study. *BMJ* 2011; **342** d142.
93. Miravittles M, Anzueto A, Legnani D, Forstmeier L, Fargel M. Patient's Perception of Exacerbations of COPD--the PERCEIVE Study. *Respir Med* 2007; **101**(3): 453-460.
94. Kessler R, Stahl E, Vogelmeier C, Haughney J, Trudeau E, Lofdahl CG, Partridge MR. Patient Understanding, Detection, and Experience of COPD Exacerbations: an Observational, Interview-Based Study. *Chest* 2006; **130**(1): 133-142.
95. Bailey PH. Death Stories: Acute Exacerbations of Chronic Obstructive Pulmonary Disease. *Qual Health Res* 2001; **11**(3): 322-338.
96. Shepperd S, Doll H, Angus RM, Clarke MJ, Liffe S, Kalra L, Ricauda NA, Wilson AD. Hospital at Home Admission Avoidance. *Cochrane Database Syst Rev* 2011; **8**.
97. Cotton MM, Bucknall CE, Dagg KD, Johnson MK, MacGregor G, Stewart C, Stevenson RD. Early Discharge for Patients With Exacerbations of Chronic Obstructive Pulmonary Disease: a Randomized Controlled Trial. *Thorax* 2000; **55**(11): 902-906.
98. Davies L, Wilkinson M, Bonner S, Calverley PM, Angus RM. "Hospital at Home" Versus Hospital Care in Patients With Exacerbations of Chronic Obstructive Pulmonary Disease: Prospective Randomised Controlled Trial. *BMJ* 2000; **321**(7271): 1265-1268.
99. Hernandez C, Casas A, Escarrabill J, Alonso J, Puig-Junoy J, Farrero E, Vilagut G, Collvinent B, Rodriguez-Roisin R, Roca J. Home Hospitalisation of Exacerbated Chronic Obstructive Pulmonary Disease Patients. *Eur Respir J* 2003; **21**(1): 58-67.

100. Ojoo JC, Moon T, McGlone S, Martin K, Gardiner ED, Greenstone MA, Morice AH. Patients' and Carers' Preferences in Two Models of Care for Acute Exacerbations of COPD: Results of a Randomised Controlled Trial. *Thorax* 2002; **57**(2): 167-169.
101. Skwarska E, Cohen G, Skwarski KM, Lamb C, Bushell D, Parker S, MacNee W. Randomized Controlled Trial of Supported Discharge in Patients With Exacerbations of Chronic Obstructive Pulmonary Disease. *Thorax* 2000; **55**(11): 907-912.
102. Aimonino RN, Tibaldi V, Leff B, Scarafioti C, Marinello R, Zanocchi M, Molaschi M. Substitutive "Hospital at Home" Versus Inpatient Care for Elderly Patients With Exacerbations of Chronic Obstructive Pulmonary Disease: a Prospective Randomized, Controlled Trial. *J Am Geriatr Soc* 2008; **56**(3): 493-500.
103. Nicholson C, Bowler S, Jackson C, Schollay D, Tweeddale M, O'Rourke P. Cost Comparison of Hospital- and Home-Based Treatment Models for Acute Chronic Obstructive Pulmonary Disease. *Aust Health Rev* 2001; **24**(4): 181-187.
104. Jeppesen E, Brurberg KG, Vist GE, Wedzicha JA, Wright JJ, Greenstone M, Walters JA. Hospital at Home for Acute Exacerbations of Chronic Obstructive Pulmonary Disease. *Cochrane Database Syst Rev* 2012; **5** CD003573.
105. Arras JD, Dubler NN. Bringing the Hospital Home: Ethical and Social Implications of High-Tech Home Care. *Hastings Cent Rep* 1994; **24**(5 Suppl): S19-S28.
106. Leff B, Burton L, Mader SL, Naughton B, Burl J, Koehn D, Clark R, Greenough WB, III, Guido S, Steinwachs D, Burton JR. Comparison of Stress Experienced by Family Members of Patients Treated in Hospital at Home With That of Those Receiving Traditional Acute Hospital Care. *J Am Geriatr Soc* 2008; **56**(1): 117-123.
107. Gunnell D, Coast J, Richards SH, Peters TJ, Pounsford JC, Darlow MA. How Great a Burden Does Early Discharge to Hospital-at-Home Impose on Carers? A Randomized Controlled Trial. *Age Ageing* 2000; **29**(2): 137-142.
108. Burns KE, Adhikari NK, Keenan SP, Meade M. Use of Non-Invasive Ventilation to Wean Critically Ill Adults Off Invasive Ventilation: Meta-Analysis and Systematic Review. *BMJ* 2009; **338** b1574.
109. Hudson B. Integrated Care and Structural Change in England: The Case of Care Trusts. *Policy Studies* 2002; **23**(2): 77-95.
110. Kodner D.L., Kyriacou C.K. Fully Integrated Care for Frail Elderly: Two American Models. *International Journal of Integrated Care* 2000; **1**.
111. Nici L, Zuwallack R. An Official American Thoracic Society Workshop Report: the Integrated Care of The COPD Patient. *Proc Am Thorac Soc* 2012; **9**(1): 9-18.
112. Wagner EH, Austin BT, Von KM. Improving Outcomes in Chronic Illness. *Manag Care Q* 1996; **4**(2): 12-25.
113. Wagner EH, Austin BT, Davis C, Hindmarsh M, Schaefer J, Bonomi A. Improving Chronic Illness Care: Translating Evidence into Action. *Health Aff (Millwood)* 2001; **20**(6): 64-78.

114. Coast J, Richards SH, Peters TJ, Gunnell DJ, Darlow MA, Pounsford J. Hospital at Home or Acute Hospital Care? A Cost Minimisation Analysis. *BMJ* 1998; **316**(7147): 1802-1806.
115. Leff B, Burton L, Mader SL, Naughton B, Burl J, Inouye SK, Greenough WB, III, Guido S, Langston C, Frick KD, Steinwachs D, Burton JR. Hospital at Home: Feasibility and Outcomes of a Program to Provide Hospital-Level Care at Home for Acutely Ill Older Patients. *Ann Intern Med* 2005; **143**(11): 798-808.
116. Wilson A, Parker H, Wynn A, Jagger C, Spiers N, Jones J, Parker G. Randomised Controlled Trial of Effectiveness of Leicester Hospital at Home Scheme Compared With Hospital Care. *BMJ* 1999; **319**(7224): 1542-1546.
117. Bourbeau J, Julien M, Maltais F, Rouleau M, Beaupre A, Begin R, Renzi P, Nault D, Borycki E, Schwartzman K, Singh R, Collet JP. Reduction of Hospital Utilization in Patients With Chronic Obstructive Pulmonary Disease: a Disease-Specific Self-Management Intervention. *Arch Intern Med* 2003; **163**(5): 585-591.
118. Casas A, Troosters T, Garcia-Aymerich J, Roca J, Hernandez C, Alonso A, del PF, de TP, Anto JM, Rodriguez-Roisin R, Decramer M. Integrated Care Prevents Hospitalisations for Exacerbations in COPD Patients. *Eur Respir J* 2006; **28**(1): 123-130.
119. Koff PB, Jones RH, Cashman JM, Voelkel NF, Vandivier RW. Proactive Integrated Care Improves Quality of Life in Patients With COPD. *Eur Respir J* 2009; **33**(5): 1031-1038.
120. Rice KL, Dewan N, Bloomfield HE, Grill J, Schult TM, Nelson DB, Kumari S, Thomas M, Geist LJ, Beaner C, Caldwell M, Niewoehner DE. Disease Management Program for Chronic Obstructive Pulmonary Disease: a Randomized Controlled Trial. *Am J Respir Crit Care Med* 2010; **182**(7): 890-896.
121. . Pulmonary Rehabilitation: Joint ACCP/AACVPR Evidence-Based Guidelines. ACCP/AACVPR Pulmonary Rehabilitation Guidelines Panel. American College of Chest Physicians. American Association of Cardiovascular and Pulmonary Rehabilitation. *Chest* 1997; **112**(5): 1363-1396.
122. Moullec G, Ninot G. An Integrated Programme After Pulmonary Rehabilitation in Patients With Chronic Obstructive Pulmonary Disease: Effect on Emotional and Functional Dimensions of Quality of Life. *Clin Rehabil* 2010; **24**(2): 122-136.
123. Spencer LM, Alison JA, McKeough ZJ. Maintaining Benefits Following Pulmonary Rehabilitation: a Randomised Controlled Trial. *Eur Respir J* 2010; **35**(3): 571-577.
124. Halting AG, Heggdal K. Patients' Experiences of Health Transitions in Pulmonary Rehabilitation. *Nurs Inq* 2012; **19**(4): 345-356.
125. Bischoff EW, Hamd DH, Sedeno M, Benedetti A, Schermer TR, Bernard S, Maltais F, Bourbeau J. Effects of Written Action Plan Adherence on COPD Exacerbation Recovery. *Thorax* 2011; **66**(1): 26-31.
126. Wilkinson TM, Donaldson GC, Hurst JR, Seemungal TA, Wedzicha JA. Early Therapy Improves Outcomes of Exacerbations of Chronic Obstructive Pulmonary Disease. *Am J Respir Crit Care Med* 2004; **169**(12): 1298-1303.

127. Clarke A, Sohanpal R, Wilson G, Taylor S. Patients' Perceptions of Early Supported Discharge for Chronic Obstructive Pulmonary Disease: a Qualitative Study. *Qual Saf Health Care* 2010; **19**(2): 95-98.
128. Monninkhof E, van der Aa M, van d, V, van der Palen J, Zielhuis G, Koning K, Pieterse M. A Qualitative Evaluation of a Comprehensive Self-Management Programme for COPD Patients: Effectiveness From the Patients' Perspective. *Patient Educ Couns* 2004; **55**(2): 177-184.
129. Schofield I, Knussen C, Tolson D. A Mixed Method Study to Compare Use and Experience of Hospital Care and a Nurse-Led Acute Respiratory Assessment Service Offering Home Care to People With an Acute Exacerbation of Chronic Obstructive Pulmonary Disease. *Int J Nurs Stud* 2006; **43**(4): 465-476.
130. World Health Organization. International Statistical Classification of Diseases and Related Health Problems 10th Revision, <http://apps.who.int/classifications/icd10/browse/2010/en>.
131. Gulsvik A, Tosteson T, Bakke P, Humerfelt S, Weiss ST, Speizer FE. Expiratory and Inspiratory Forced Vital Capacity and One-Second Forced Volume in Asymptomatic Never-Smokers in Norway. *Clin Physiol* 2001; **21**(6): 648-660.
132. Rosenbaum PR, Rubin DB. The Central Role of the Propensity Score in Observational Studies for Causal Effects. *Biometrika* 1983; **70** 41-55.
133. Kvale S, Brinkmann S. *InterViews: Learning the Craft of Qualitative Research Interviewing*; Sage Publications: 2008.
134. Malterud K. Qualitative Research: Standards, Challenges, and Guidelines. *Lancet* 2001; **358**(9280): 483-488.
135. Malterud K. Systematic Text Condensation: a Strategy for Qualitative Analysis. *Scand J Public Health* 2012; **40**(8): 795-805.
136. Malterud K. The Art and Science of Clinical Knowledge: Evidence Beyond Measures and Numbers. *Lancet* 2001; **358**(9279): 397-400.
137. Burkett GL, Godkin MA. Qualitative Research in Family Medicine. *J Fam Pract* 1983; **16**(3): 625-626.
138. Yamazaki H, Slingsby BT, Takahashi M, Hayashi Y, Sugimori H, Nakayama T. Characteristics of Qualitative Studies in Influential Journals of General Medicine: a Critical Review. *Biosci Trends* 2009; **3**(6): 202-209.
139. Brekke PH. Myocardial injury in patients hospitalised for exacerbation of chronic obstructive pulmonary disease. [954]. 2010. Oslo, University of Oslo, Faculty of Medicine.
140. Barba R, Zapatero A, Losa JE, Marco J, Plaza S, Rosado C, Canora J. The Impact of Weekends on Outcome for Acute Exacerbations of COPD. *Eur Respir J* 2012; **39**(1): 46-50.
141. Cohen J. *Statistical Analysis for the Behavioral Sciences*; Erlbaum: 1988.

142. Gum PA, Thamilarasan M, Watanabe J, Blackstone EH, Lauer MS. Aspirin Use and All-Cause Mortality Among Patients Being Evaluated for Known or Suspected Coronary Artery Disease: A Propensity Analysis. *JAMA* 2001; **286**(10): 1187-1194.
143. Stenestrand U, Wallentin L. Early Statin Treatment Following Acute Myocardial Infarction and 1-Year Survival. *JAMA* 2001; **285**(4): 430-436.
144. Thabut G, Christie JD, Ravaud P, Castier Y, Brugiere O, Fournier M, Mal H, Leseche G, Porcher R. Survival After Bilateral Versus Single Lung Transplantation for Patients With Chronic Obstructive Pulmonary Disease: a Retrospective Analysis of Registry Data. *Lancet* 2008; **371**(9614): 744-751.
145. Braitman LE, Rosenbaum PR. Rare Outcomes, Common Treatments: Analytic Strategies Using Propensity Scores. *Ann Intern Med* 2002; **137**(8): 693-695.
146. Luo Z, Gardiner JC, Bradley CJ. Applying Propensity Score Methods in Medical Research: Pitfalls and Prospects. *Med Care Res Rev* 2010; **67**(5): 528-554.
147. Taylor SJ, Candy B, Bryar RM, Ramsay J, Vrijhoef HJ, Esmond G, Wedzicha JA, Griffiths CJ. Effectiveness of Innovations in Nurse Led Chronic Disease Management for Patients With Chronic Obstructive Pulmonary Disease: Systematic Review of Evidence. *BMJ* 2005; **331**(7515): 485.
148. Cowie MR, Wood DA, Coats AJ, Thompson SG, Suresh V, Poole-Wilson PA, Sutton GC. Survival of Patients With a New Diagnosis of Heart Failure: a Population Based Study. *Heart* 2000; **83**(5): 505-510.
149. Solano JP, Gomes B, Higginson IJ. A Comparison of Symptom Prevalence in Far Advanced Cancer, AIDS, Heart Disease, Chronic Obstructive Pulmonary Disease and Renal Disease. *J Pain Symptom Manage* 2006; **31**(1): 58-69.
150. Harding R, Selman L, Beynon T, Hodson F, Coady E, Read C, Walton M, Gibbs L, Higginson IJ. Meeting the Communication and Information Needs of Chronic Heart Failure Patients. *J Pain Symptom Manage* 2008; **36**(2): 149-156.
151. Selman L, Harding R, Beynon T, Hodson F, Coady E, Hazeldine C, Walton M, Gibbs L, Higginson IJ. Improving End-of-Life Care for Patients With Chronic Heart Failure: "Let's Hope It'll Get Better, When I Know in My Heart of Hearts It Won't". *Heart* 2007; **93**(8): 963-967.
152. Baker DW, Einstadter D, Husak SS, Cebul RD. Trends in Postdischarge Mortality and Readmissions: Has Length of Stay Declined Too Far? *Arch Intern Med* 2004; **164**(5): 538-544.
153. Tsimogianni AM, Papiris SA, Stathopoulos GT, Manali ED, Roussos C, Kotanidou A. Predictors of Outcome After Exacerbation of Chronic Obstructive Pulmonary Disease. *J Gen Intern Med* 2009; **24**(9): 1043-1048.
154. Stolz D, Christ-Crain M, Morgenthaler NG, Leuppi J, Miedinger D, Bingisser R, Muller C, Struck J, Muller B, Tamm M. Copeptin, C-Reactive Protein, and Procalcitonin As Prognostic Biomarkers in Acute Exacerbation of COPD. *Chest* 2007; **131**(4): 1058-1067.

155. Ban A, Ismail A, Harun R, Abdul RA, Sulung S, Syed MA. Impact of Clinical Pathway on Clinical Outcomes in the Management of COPD Exacerbation. *BMC Pulm Med* 2012; **12** 27.
156. Earnest A, Chen MI, Seow E. Exploring If Day and Time of Admission Is Associated With Average Length of Stay Among Inpatients From a Tertiary Hospital in Singapore: an Analytic Study Based on Routine Admission Data. *BMC Health Serv Res* 2006; **6** 6.
157. Suissa S, Dell'Aniello S, Ernst P. Long-Term Natural History of Chronic Obstructive Pulmonary Disease: Severe Exacerbations and Mortality. *Thorax* 2012; **67**(11): 957-963.
158. Hurst JR, Donaldson GC, Quint JK, Goldring JJ, Baghai-Ravary R, Wedzicha JA. Temporal Clustering of Exacerbations in Chronic Obstructive Pulmonary Disease. *Am J Respir Crit Care Med* 2009; **179**(5): 369-374.
159. Almagro P, Barreiro B, Ochoa de EA, Quintana S, Rodriguez CM, Heredia JL, Garau J. Risk Factors for Hospital Readmission in Patients With Chronic Obstructive Pulmonary Disease. *Respiration* 2006; **73**(3): 311-317.
160. Cakir B, Gammon G. Evaluating Readmission Rates: How Can We Improve? *South Med J* 2010; **103**(11): 1079-1083.
161. Fan VS, Gaziano JM, Lew R, Bourbeau J, Adams SG, Leatherman S, Thwin SS, Huang GD, Robbins R, Sriram PS, Sharafkhaneh A, Mador MJ, Sarosi G, Panos RJ, Rastogi P, Wagner TH, Mazzuca SA, Shannon C, Colling C, Liang MH, Stoller JK, Fiore L, Niewoehner DE. A Comprehensive Care Management Program to Prevent Chronic Obstructive Pulmonary Disease Hospitalizations: a Randomized, Controlled Trial. *Ann Intern Med* 2012; **156**(10): 673-683.
162. Benbassat J, Taragin MI. The Effect of Clinical Interventions on Hospital Readmissions: a Meta-Review of Published Meta-Analyses. *Isr J Health Policy Res* 2013; **2**(1): 1.
163. Bourbeau J, Collet JP, Schwartzman K, Ducruet T, Nault D, Bradley C. Economic Benefits of Self-Management Education in COPD. *Chest* 2006; **130**(6): 1704-1711.
164. Bourbeau J, van der Palen J. Promoting Effective Self-Management Programmes to Improve COPD. *Eur Respir J* 2009; **33**(3): 461-463.
165. World Health Organization: Innovative Care for Chronic Health Conditions. Building Blocks for Action. Global report. 2002. ISBN924 159 0173. Originally distributed as WHO/MNC/CCH/02.01
166. Sochalski J, Jaarsma T, Krumholz HM, Laramée A, McMurray JJ, Naylor MD, Rich MW, Riegel B, Stewart S. What Works in Chronic Care Management: the Case of Heart Failure. *Health Aff (Millwood)* 2009; **28**(1): 179-189.
167. Attree M. Patients' and Relatives' Experiences and Perspectives of 'Good' and 'Not So Good' Quality Care. *J Adv Nurs* 2001; **33**(4): 456-466.
168. Holman H, Lorig K. Patients As Partners in Managing Chronic Disease. Partnership Is a Prerequisite for Effective and Efficient Health Care. *BMJ* 2000; **320**(7234): 526-527.

169. Frank A.W. Relations of Caring: Demoralization and Remoralization in the Clinic. *International Journal for Human Caring* 2002; **6**(2): 13-19.
170. Oxman AD, Bjørndal A, Flottorp SA, Lewin S, Lindahl, AK. Integrated Health Care for People with Chronic Conditions. A policy brief. Norwegian Knowledge Centre for the Health Services. Oslo. 2008. <http://www.kunnskapssenteret.no/Publikasjoner/5114.cms>
171. Holman H, Lorig K. Patient Self-Management: a Key to Effectiveness and Efficiency in Care of Chronic Disease. *Public Health Rep* 2004; **119**(3): 239-243.

9 Appendix

INTERVJUGUIDE 1

For hjemmebehandlede pasienter

[Innledning - informasjon om intervjuet]

- Informer om formålet med intervjuet og at det vil ta ca 1--1,5 time.
- Spør om å få tillatelse til å ta opp samtalen på band (- lydbandopptak) for å kunne transkribere senere.

TEMAER

[1. Litt om sykehistorie og behandlingsapparat]

- Hvor lenge har du hatt KOLS?
- Har du deltatt i noen behandlingsprogram for KOLS tidligere?
(slik som KOLS-skole, fysioterapi eller andre rehabiliteringsprogram)
- Har du opplevd liknende episoder før - at du har vært så dårlig over flere dager at du har blitt lagt inn på sykehuset (pga KOLS), (Fortell litt om (en) tidligere sykehusinnleggelse...).

[2. Behandlingsopplegget "sykehusbehandling i hjemmet"]

- **Kan du fortelle om sykehusinnleggelsen (nå sist) - og hjemmebehandlingen?**
 1. Hvordan "så" dagene dine ut disse 3 dagene du fikk "sykehusbehandling i hjemmet"? (- fra morgen til kveld og natt mht pleie/stell, behandling, mat, røyking osv.)
 2. Fortelle litt om behandlingsopplegget (prøver som ble tatt, behandlinger og hjelp/veiledning)
 3. Var du i kontakt med andre på sykehuset i løpet av disse 3 dagene?
(- Hvem kontaktet du, hvordan og hvorfor?)
 4. Fikk du hjelp av andre disse 3 dagene – eller klarte du deg selv etter de daglige hjemmebesøkene fra sykehuset?
(Hva fikk du eventuelt hjelp til - og av hvem (pårørende/familie, venner/naboer, kommunal pleie- og omsorgstjeneste?)

[3. Behandlingsutbytte fra "sykehusbehandling i hjemmet"]

- **Hvordan har du det nå?**
- **Er det noe fra behandlingsopplegget - "sykehusbehandling i hjemmet" - du kan bruke i dagliglivet etterpå?**
- Har behandlingsopplegget gitt deg noe – eller var det bare (nødvendig) hjelp der og da? (- mtp handtering av KOLS, medisiner, bruk av medisinsk utstyr/tekniske hjelpemidler, kosthold/ernæring, røykevaner/røykeslutt m.m)

[4. Opplevelser av og begrensninger ved behandlingsopplegget]

- **Hvordan opplevde du det å få sykehusbehandling i ditt eget hjem - fremfor på sykehus?** (- positivt/negativt, fordeler/ulempes mtp behandlingsopplegg/-rammer)
- **Hvordan tror du dine nærmeste**
(ektefelle/samboer, pårørende/familie) opplevde det at du fikk
"sykehusbehandling i hjemmet" – fremfor på sykehus?
- **Er det noe ved behandlingsopplegget "sykehusbehandling i hjemmet" som burde være annerledes, synes du?**
(Negative sider/ulempes – ved behandlingsopplegget/-rammene?)
- **Om du får tilbud om å få hjemmebehandling en gang til, ville du ha valgt det igjen? Hvorfor?**

[5. Avslutning]

- **Jeg har fått svar på det jeg ønsket å snakke med deg om!**
 1. Er det noe vi ikke har snakket om - i forhold til "sykehusbehandling i hjemmet"?
 2. Eller noe du vil tilføye tilslutt?
- **Tusen takk for all informasjon jeg har fått fra deg!**
 1. Hvis det er noe du kommer på i ettertid, må du gjerne kontakte meg igjen.

INTERVJUGUIDE 2

For sykehusbehandlede pasienter

1. Kort innledning om formålet med intervju er at vi gjerne vil høre om pasientens opplevelse om sykehusinnleggelse under KOLS-forverring.
 - Hvordan så dagene ut de dagene du lå på sykehuset?
 - Hvordan synes du behandlingen har vært på sykehuset?
 - Tror du det ville ha sett annerledes ut hvis du var hjemme?
 - Svarer opplevelse forventningene du hadde før du ble innlagt?
 - Er det noe du savner ved sykehusoppholdet?
 - Hvordan opplevde dine pårørende sykehusoppholdet?
 - Har du fått noe igjen (noe info/kunnskap om KOLS) etter sykehusoppholdet?
2. Hvorfor ville du delta prosjektet?

10. Errata

- 1) Side 8, Abbreviation.
From "AECOPD Acute exacerbation of chronic obstructive lung disease"
To "AECOPD Acute exacerbation of chronic obstructive pulmonary disease"
- 2) Side 13, Section 1.2.1, paragraph 3, 2nd sentence.
From "American Thoracic Society (ATS) and European Respiratory Society (ERS)"
To "ATS and ERS".
- 3) Side 14, Section 1.2.2, paragraph 1, 4th and 5th sentence.
From "Both long and short LOS is associated ..."
To "Both long and short LOS had been associated ...".
- 4) Side 14, Section 1.2.2, paragraph 2, 1st sentence.
From "Different variables are associated with long LOS, such as social/demographic data, clinical variables, co-morbidities, number and type of drugs used and day of the week for admission are associated with long hospital stays in acute exacerbation of COPD"
To "Different variables have been associated with long LOS in acute exacerbation of COPD, such as social/demographic data, clinical variables, co-morbidities, number and type of drugs used and day of the week for admission."
- 5) Side 14, section 1.2.2, paragraph 3, 4th sentence.
From "Increased knowledge about predictors of length of stay (LOS) may ..."
To "Increased knowledge about predictors of length of stay may contribute..."
- 6) S16, section 1.2.5, 2nd sentence.
From "...treatment of prevention ..." To "...treatment of exacerbation ..."
- 7) S16, section 1.2.5.1, 1st sentence.
From "HaH has ..." to "Hospital at home (HaH) has ..."
- 8) Side 20, section 1.2.6, 1st paragraph, 3rd sentence.
From "A survey showed more satisfaction in patients in the HaH programme than with patients receiving..."
To "A survey showed more satisfaction in patients in the HaH programme than patients receiving..."
- 9) Side 25, section 3.1.5, paragraph 2, 5th sentence.
From "After matching process, we got to comparable patients..."
To "After matching process, we got two comparable patients..."
- 10) Side 27, section 3.2.4, paragraph 1, 2nd sentence.
From "This methods...." to "This method....".
- 11) Side 36, section 5.1.3.2, paragraph 1, 2nd sentence.
From "The interviews were audio-taped transcribed word by word right after the interview by me self."
To "The interviews were audio-taped and transcribed word by word right after the interview by myself."

FACTORS ASSOCIATED WITH A LONG HOSPITAL STAY IN PATIENTS WITH ACUTE EXACERBATION OF COPD

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Conflict of interest statement

The authors have no conflicts of interest to declare.

Authors' contributions

YW (e-mail: ying.wang@ahus.no): contributed to study design, and is main responsible for data collection, analyses and interpretation of data, drafting of the manuscript and final approval of the manuscript. YW has no conflict to declare.

KS (e-mail: knut.stavem@medisin.uio.no): contributed to study design, analyses and interpretation of data, draft and revision of the article and approved the final manuscript. KS has no conflict to declare.

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Abstract

Background

Reduction of the length of stay (LOS) in acute exacerbation of chronic obstructive pulmonary disease (AECOPD) requires the ability to identify patients who may require a long stay. This study assessed the association between variables obtained on hospital admission and long LOS, aiming to establish a prediction model for LOS.

Methods

We extracted demographic and clinical data from the medical records of 599 patients discharged after an AECOPD episode between March 2006 and December 2008 at Oslo University Hospital, Aker. We used univariate and multivariate logistic regression analyses to assess predictors of a LOS above the 75th percentile and assessed the area under the operating characteristic curve (AUC) to evaluate the model's performance.

Results

We included 590 patients (54% women) aged 73.2 ± 10.8 years (mean \pm SD) in the analyses. Median LOS was 6.0 days (IQR 3.5–11.0). In multivariate analysis, admission during Thursday–Saturday (OR 2.24 [95% CI 1.60–3.51], $p < 0.001$), ≥ 1 comorbidity (OR 2.08 [95% CI 1.08–4.02], $p = 0.028$), high PaCO₂ (OR 1.26 [95% CI 1.13–1.41], $p < 0.001$) and low albumin level (OR 0.92 [95% CI 0.87–0.97], $p = 0.001$) were associated with a LOS of > 11 days. The statistical model had an AUC of 0.70.

Conclusion

Admission on Thursday–Saturday, comorbidities, high PaCO₂ and low albumin level were associated with a long LOS. These findings may help physicians to identify patients that will need a long LOS in the early stages of admission. However, the predictive model exhibited suboptimal performance and hence is not ready for clinical use.

Introduction

Hospitalization for acute exacerbation of chronic obstructive pulmonary disease (AECOPD) is recognized as a major event in the natural history of chronic obstructive pulmonary disease (COPD) due to its negative effect on lung function, survival, risk of readmission and quality of life.¹⁻⁶ Although only 10–15% of all patients with COPD will experience severe exacerbations that require hospital admission, the expenditure on hospitalization represents more than 70% of all COPD-related medical care costs.⁷ The mean length of stay (LOS) for patients hospitalized for AECOPD is long, reportedly ranging from 3 to 16 days.^{8,9}

Various variables like social/demographic data,^{10,11} clinical variables,^{9,12-14} comorbidities,¹⁵⁻¹⁸ number and type of drugs used,¹⁹ and day of the week of the admission¹⁶ are associated with long hospital stays in AECOPD. However, there is little consistency in the predictors of long LOS identified by different studies. To our knowledge, there are no established statistical models for predicting LOS based on variables collected at the time of hospital admission for AECOPD. Increased knowledge about predictors of the LOS might contribute to better discharge planning and shortening of the LOS.

The primary objective of this retrospective study was to identify factors associated with a long LOS—defined as longer than the 75th percentile—in patients hospitalized for AECOPD. A secondary objective was to develop a predictive model for LOS based on available variables obtained at the time of admission for AECOPD.

Material and methods

Patients

The study included all patients with a discharge diagnosis of COPD between March 2006 and December 2008 at Oslo University Hospital, Aker. We included patients with COPD (J43 or J44) based on the International Statistical Classification of Disease and Related Health Problems, 10th Revision (ICD-10)²⁰ as the main diagnosis, or respiratory failure (J96) or pneumonia (J12–J18) as the main diagnosis with COPD (J43 or J44) as a secondary diagnosis. We only included the first hospitalization for patients with multiple hospitalizations during this period. In total, 599 patients were included.

Medical record review and variables

We extracted the following data from the computerized medical record at the time of hospital admission: demographic data, number of comorbidities, use of long-term oxygen therapy and clinical data obtained in the emergency department (Table 1). As comorbidities, we registered a history of any of the following conditions: ischemic heart disease, cardiac arrhythmias, congestive heart failure, cor pulmonale or pulmonary hypertension, psychiatric disorder, general atherosclerosis, cerebral insult, diabetes mellitus, other neurologic disorders than cerebral insult, any malignancy ever, osteoporosis, kidney failure, or abuse of drugs or alcohol.

We also extracted the value of the forced expiratory volume in 1 s (FEV₁) determined at the time closest to that of the admission, LOS, number of COPD-related admissions during the previous 12 months before the current admission and the day of the week of the admission. In the analyses we dichotomized day of the week into Thursday–Saturday and Sunday–Wednesday, because we considered that the natural time of discharge for those admitted during Thursday–Saturday would be before the following weekend and thus that

they might have a higher risk of a prolonged stay. A COPD-related admission was defined by discharge diagnoses from previous admissions using the same criteria as for the current admission.

This study was approved by the local Privacy Ombudsman for Clinical Research, Oslo University Hospital.

Statistical analysis

Based on a literature review we analysed how 14 variables from our data set were related to LOS (Table 1). Descriptive statistics are expressed as mean \pm SD or median [interquartile range (IQR)] values for continuous data, and number (%) values for categorical data. Missing values for FEV₁, serum albumin level and the partial carbon dioxide tension in arterial blood (PaCO₂) were imputed from the other known variables using multiple linear regression analysis; we did not impute missing values for the other variables. Patients with missing values after this procedure were excluded from the final analysis. We used univariate and multivariate logistic regression analyses to assess predictors of a LOS of >11 days (corresponding to >75th percentile). The multivariable analysis initially included variables with $p \leq 0.25$ in the univariate analysis. We then manually removed variables one by one while watching changes in the coefficients in order to arrive at a final parsimonious model. We chose a significance level of 5%. Stata software (version 10.1) was used for statistical analysis (Stata Corp, College Station, TX, USA).

In an attempt to establish a statistical model to predict whether or not a patient would be hospitalized for longer than the 75th percentile, receiver operating characteristic (ROC) analysis was performed for independent predictors of a long LOS as determined by multivariate logistic regression analysis.

Results

Study subjects

Of 599 patients discharged after AECOPD, 9 were excluded from further analysis due to missing data after our imputation of FEV₁, serum albumin and PaCO₂ values. The final sample of 590 patients had a mean age of 73.2±10.8 years and comprised 54% females. The mean LOS was 8.9±9.7 days, with a median of 6 days (IQR 3.5–11.0 days). Descriptive statistics for the patients are presented in Table 1.

In univariate analysis, FEV₁, COPD-related admission during the previous 12 months before the current admission, admission during Thursday–Saturday, having at least one comorbidity, high PaCO₂ and low serum albumin level were significantly associated with a LOS longer than 11 days ($p<0.05$, Table 2).

In multivariate analysis, only admission during Thursday–Saturday, having comorbidity, high PaCO₂ and low serum albumin level were independently associated with a long LOS (Table 3). Admission during Thursday–Saturday increased the odds ratio (OR) of a LOS longer than 11 days to 2.24 [95% confidence interval (CI) 1.60–3.51]. The OR for the presence of comorbidity compared with no comorbidity was 2.08 (95% CI 1.08–4.02). An increase of 1 kPa in PaCO₂ had an OR of 1.26 (95% CI 1.13–1.41), and an increasing serum albumin level was associated with a shorter LOS (OR 0.92 [95% CI 0.87–0.97]). The area under the ROC curve was 0.70 (Figure 1).

Discussion

This study found that admission from Thursday through Saturday, comorbidities, high PaCO₂ and low serum albumin level were independently associated with a long LOS. However, the statistical model had an area under the ROC curve of 0.70, which we considered to be too low to allow the development of a meaningful predictive model.

Our finding that admission during Thursday–Saturday was associated with a LOS greater than the 75th percentile (i.e., 11 days) is consistent with a Spanish study demonstrating an association between weekend admission (Friday–Sunday) and prolonged LOS.¹⁶ However, a long LOS was defined as ≥ 3 days in the Spanish study, which is shorter than the median in the present study, and shorter than the commonly reported mean or median LOS of 6–11 days.²¹ Studies of other diseases have also found that the admission day of the week affects the LOS.^{22,23} There are several possible explanations of this phenomenon, and they probably vary between specific health systems. In our case it might be that the “natural” discharge day of these patients was immediately before the next weekend, as indicated by the median LOS, and hence the discharge could be delayed by the discontinuity and reduction of the medical staff during weekends, as suggested by previous studies.^{16,22} This phenomenon might also be due to the reduced primary health care or support available from relatives following the hospital discharge.

The association between LOS and comorbidity—which is common in COPD—was less surprising, and supports the findings of previous studies.¹⁵⁻¹⁸

That a high PaCO₂ measured in the emergency department was associated with a prolonged LOS is reasonable because PaCO₂ and other blood-gas variables reflect the severity of respiratory failure. This finding is consistent with two previous studies^{12,24} but inconsistent with two others.^{25,26} The discrepant results of these studies may be due to differences between the patient populations, since patients needing intensive care²⁶ and with infiltration on chest radiographs²⁵ were excluded from the latter two studies.

Our finding of an association of low serum albumin with a long LOS is consistent with a British study demonstrating an association between a low serum albumin level and a LOS of >7 days.²⁴ The serum albumin level is a marker of nutritional status,²⁷ with a low level being associated with higher long-term mortality in COPD patients.^{2,28} Albumin also forms a part of

the acute-phase protein response, and hence low serum albumin may reflect the deterioration of clinical status or increased persistent inflammation during AECOPD.²⁸

In the present study we wanted to identify patients with anticipated long LOS primarily because such patients may have a worse health status and hence an increased need for post-discharge support.²⁹ We decide to use a LOS cutoff of the 75th percentile rather than the median based on the assumption that the potential benefit from improved discharge planning would be greater for the former.

The predictive model did not perform as well as we had anticipated. The area under the ROC curve was only 0.7, suggesting a poor to fair performance. One example of why we are not satisfied with the predictability of the model is that if we wanted it to identify 90% of all patients with a LOS of >11 days (i.e. a sensitivity of 0.90), then according to the ROC curve the specificity would be 0.33; that is, in 67% of cases the model would have picked up patients with a LOS of ≤11 days. Such a high false-positive rate would make the predictive model of little use in clinical practice. There may be several reasons for the suboptimal performance of this model, with one possibility being the presence of a large random component that is independent of patient-related variables. Previous studies found that only 8–12% of the LOS variation could be explained by clinical variables;^{14,25} local practice guidelines, hospital resources and the organization of care could be such independent components.^{24,30}

Some limitations of this retrospective study should be discussed. Firstly, the number of variables used in the analyses was limited, meaning that potentially important predictors might have been missed. However, we reduced the possibility of false-positive findings by including large numbers of variables in the analysis. Secondly, some medical records at the time of the admission were incomplete, for example, lacked information on comorbidities or results of test actually being done on admission. This was partially compensated by imputing

values for missing values for variables that we thought would be most important: FEV₁, PaCO₂ and albumin. This imputation contributed to reduce the uncertainty associated with missing data and avoid the exclusion of patients, which would have reduced the statistical power of the study.

Lastly, the study population was recruited from a single university hospital in Oslo, and it might not be representative of other regions. However, the included population was relatively large and was unselected in that all patients with a discharge diagnosis of COPD were included. Furthermore, both age and LOS in our study were comparable to those in previous larger studies,^{24,31} which support the representativity of our sample.

In conclusion, we found that the admission day of the week, comorbidities, PaCO₂ and serum albumin level were associated with the LOS. The reported findings may help physicians to identify patients at risk of a long LOS in the early stages of an AECOPD admission. However, we were unable to create a robust scoring model for risk stratification that would have been useful for discharge planning. The reasons for prolonged LOS are probably multidimensional, and future studies should focus on both patient- and non-patient-related factors.

References

1. Almagro P, Barreiro B, Ochoa de EA, Quintana S, Rodriguez CM, Heredia JL, Garau J. Risk Factors for Hospital Readmission in Patients With Chronic Obstructive Pulmonary Disease. *Respiration* 2006; **73**(3): 311-317.
2. Connors AF, Jr., Dawson NV, Thomas C, Harrell FE, Jr., Desbiens N, Fulkerson WJ, Kussin P, Bellamy P, Goldman L, Knaus WA. Outcomes Following Acute Exacerbation of Severe Chronic Obstructive Lung Disease. The SUPPORT Investigators (Study to Understand Prognoses and Preferences for Outcomes and Risks of Treatments). *Am J Respir Crit Care Med* 1996; **154**(4 Pt 1): 959-967.
3. Donaldson GC, Seemungal TA, Bhowmik A, Wedzicha JA. Relationship Between Exacerbation Frequency and Lung Function Decline in Chronic Obstructive Pulmonary Disease. *Thorax* 2002; **57**(10): 847-852.
4. Garcia-Aymerich J, Farrero E, Felez MA, Izquierdo J, Marrades RM, Anto JM. Risk Factors of Readmission to Hospital for a COPD Exacerbation: a Prospective Study. *Thorax* 2003; **58**(2): 100-105.
5. Seemungal TA, Donaldson GC, Paul EA, Bestall JC, Jeffries DJ, Wedzicha JA. Effect of Exacerbation on Quality of Life in Patients With Chronic Obstructive Pulmonary Disease. *Am J Respir Crit Care Med* 1998; **157**(5 Pt 1): 1418-1422.
6. Soler-Cataluna JJ, Martinez-Garcia MA, Sanchez LS, Tordera MP, Sanchez PR. Severe Exacerbations and BODE Index: Two Independent Risk Factors for Death in Male COPD Patients. *Respir Med* 2009; **103**(5): 692-699.
7. Sullivan SD, Ramsey SD, Lee TA. The Economic Burden of COPD. *Chest* 2000; **117**(2 Suppl): 5S-9S.
8. Chang CL, Sullivan GD, Karalus NC, Hancox RJ, McLachlan JD, Mills GD. Audit of Acute Admissions of Chronic Obstructive Pulmonary Disease: Inpatient Management and Outcome. *Intern Med J* 2007; **37**(4): 236-241.
9. Diaz-Peromingo JA, Grandes-Ibanez J, Fandino-Org, Barcala-Villamarin P, Garrido-Sanjuan JA. Predicting Factors Contributing to Length of Stay in Hospitalized Chronic Obstructive Pulmonary Disease (COPD) Patients: the Role of the Emergency Room. *Acta Medica (Hradec Kralove)* 2004; **47**(1): 29-32.
10. Saynajakangas O, Kinnunen T, Tuuponen T, Keistinen T. Length of Stay and Interval to Readmission in Emergency Hospital Treatment of COPD. *Age Ageing* 2004; **33**(6): 567-570.
11. Wong AW, Gan WQ, Burns J, Sin DD, van Eeden SF. Acute Exacerbation of Chronic Obstructive Pulmonary Disease: Influence of Social Factors in Determining Length of Hospital Stay and Readmission Rates. *Can Respir J* 2008; **15**(7): 361-364.
12. Mushlin AI, Black ER, Connolly CA, Buonaccorso KM, Eberly SW. The Necessary Length of Hospital Stay for Chronic Pulmonary Disease. *JAMA* 1991; **266**(1): 80-83.

13. Nowinski A, Kaminski D, Korzybski D, Stoklosa A, Gorecka D. [The Impact of Comorbidities on the Length of Hospital Treatment in Patients With Chronic Obstructive Pulmonary Disease]. *Pneumonol Alergol Pol* 2011; **79**(6): 388-396.
14. Roberts CM, Lowe D, Bucknall CE, Ryland I, Kelly Y, Pearson MG. Clinical Audit Indicators of Outcome Following Admission to Hospital With Acute Exacerbation of Chronic Obstructive Pulmonary Disease. *Thorax* 2002; **57**(2): 137-141.
15. Agboado G, Peters J, Donkin L. Factors Influencing the Length of Hospital Stay Among Patients Resident in Blackpool Admitted With COPD: a Cross-Sectional Study. *BMJ Open* 2012; **2**(5).
16. de II, Valino P, Pita S, Ramos V, Pellicer C, Nicolas R, Diz-Lois F. Factors Predicting a Hospital Stay of Over 3 Days in Patients With Acute Exacerbation of Chronic Obstructive Pulmonary Disease. *J Intern Med* 2002; **251**(6): 500-507.
17. Ng TP, Niti M, Tan WC, Cao Z, Ong KC, Eng P. Depressive Symptoms and Chronic Obstructive Pulmonary Disease: Effect on Mortality, Hospital Readmission, Symptom Burden, Functional Status, and Quality of Life. *Arch Intern Med* 2007; **167**(1): 60-67.
18. Parappil A, Depczynski B, Collett P, Marks GB. Effect of Comorbid Diabetes on Length of Stay and Risk of Death in Patients Admitted With Acute Exacerbations of COPD. *Respirology* 2010; **15**(6): 918-922.
19. Incalzi RA, Pedone C, Onder G, Pahor M, Carbonin PU. Predicting Length of Stay of Older Patients With Exacerbated Chronic Obstructive Pulmonary Disease. *Aging (Milano)* 2001; **13**(1): 49-57.
20. World Health Organization. International Statistical Classification of Diseases and Related Health Problems 10th Revision, <http://apps.who.int/classifications/icd10/browse/2010/en> . 2011. 20-12-2011.
21. Roche N, Rabbat A, Zureik M, Huchon G. Chronic Obstructive Pulmonary Disease Exacerbations in Emergency Departments: Predictors of Outcome. *Curr Opin Pulm Med* 2010; **16**(2): 112-117.
22. Earnest A, Chen MI, Seow E. Exploring If Day and Time of Admission Is Associated With Average Length of Stay Among Inpatients From a Tertiary Hospital in Singapore: an Analytic Study Based on Routine Admission Data. *BMC Health Serv Res* 2006; **6** 6.
23. Horwich TB, Hernandez AF, Liang L, Albert NM, Labresh KA, Yancy CW, Fonarow GC. Weekend Hospital Admission and Discharge for Heart Failure: Association With Quality of Care and Clinical Outcomes. *Am Heart J* 2009; **158**(3): 451-458.
24. Price LC, Lowe D, Hosker HS, Anstey K, Pearson MG, Roberts CM. UK National COPD Audit 2003: Impact of Hospital Resources and Organisation of Care on Patient Outcome Following Admission for Acute COPD Exacerbation. *Thorax* 2006; **61**(10): 837-842.
25. Stolz D, Christ-Crain M, Morgenthaler NG, Leuppi J, Miedinger D, Bingisser R, Muller C, Struck J, Muller B, Tamm M. Copeptin, C-Reactive Protein, and Procalcitonin As

- Prognostic Biomarkers in Acute Exacerbation of COPD. *Chest* 2007; **131**(4): 1058-1067.
26. Tsimogianni AM, Papiris SA, Stathopoulos GT, Manali ED, Roussos C, Kotanidou A. Predictors of Outcome After Exacerbation of Chronic Obstructive Pulmonary Disease. *J Gen Intern Med* 2009; **24**(9): 1043-1048.
 27. Thorsdottir I, Gunnarsdottir I, Eriksen B. Screening Method Evaluated by Nutritional Status Measurements Can Be Used to Detect Malnourishment in Chronic Obstructive Pulmonary Disease. *J Am Diet Assoc* 2001; **101**(6): 648-654.
 28. Gunen H, Hacievliyagil SS, Kosar F, Mutlu LC, Gulbas G, Pehlivan E, Sahin I, Kizkin O. Factors Affecting Survival of Hospitalised Patients With COPD. *Eur Respir J* 2005; **26**(2): 234-241.
 29. Roche N, Zureik M, Soussan D, Neukirch F, Perrotin D. Predictors of Outcomes in COPD Exacerbation Cases Presenting to the Emergency Department. *Eur Respir J* 2008; **32**(4): 953-961.
 30. Kong GK, Belman MJ, Weingarten S. Reducing Length of Stay for Patients Hospitalized With Exacerbation of COPD by Using a Practice Guideline. *Chest* 1997; **111**(1): 89-94.
 31. Barba R, Zapatero A, Losa JE, Marco J, Plaza S, Rosado C, Canora J. The Impact of Weekends on Outcome for Acute Exacerbations of COPD. *Eur Respir J* 2012; **39**(1): 46-50.

Table 1. Descriptive statistics for patients hospitalized for COPD and included in the final analysis (n=590), mean±SD or number (%).

Variables	Values
Age, years	73.2±10.7
Sex, female	319 (54)
Mean arterial blood pressure, mmHg	104±16.4
Pulse rate, beats/min	95±21.7
PaCO ₂ , kPa	5.9±1.6
Serum albumin level, g/l	38.8±4.6
FEV ₁ , l/s	1.0 ±0.50
Patients living in an institution	61 (10)
Long-term oxygen therapy	42 (7)
X-ray findings consistent with pneumonia	176 (30)
At least one comorbidity	498 (84)
Psychiatric diagnosis	87 (15)
At least one COPD-related admission*	111 (19)
Admission Thursday–Saturday	237 (40)

PaCO₂, partial pressure of carbon dioxide in arterial blood; FEV₁, forced expiratory volume in 1 s; COPD, chronic obstructive pulmonary disease.* At least one COPD-related admission within 12 months prior to index admission

Table 2. Results of univariate logistic regression analysis of a length of stay (LOS) of >11 days vs ≤11 days during admission for acute exacerbation of COPD (n= 590).

Risk factor	Odds ratio	95% CI	<i>p</i>
Age, years	1.03	1.01 – 1.04	0.005
Sex, female vs male	0.97	0.66 – 1.40	0.852
Pulse, beats/min	1.01	1.00 – 1.01	0.185
Long-term oxygen therapy	1.21	0.60 – 2.43	0.589
Mean arterial blood pressure, mmHg	0.99	0.98 – 1.00	0.164
X-ray findings consistent with pneumonia	1.23	0.82 – 1.83	0.314
Psychiatric diagnosis	0.94	0.55 – 1.60	0.825
Patients living in an institution	1.28	0.72 – 2.31	0.401
FEV ₁ , l/s	0.64	0.42 – 0.97	0.034
At least one COPD-related admission*	1.66	1.06 – 2.59	0.027
Admission Thursday–Saturday	2.22	1.52 – 3.23	<0.001
PaCO ₂ (kPa)	1.25	1.12 – 1.40	<0.001
Serum albumin level, g/l	0.93	0.89 – 0.97	0.001
Comorbidities, ≥1 vs 0	2.50	1.32 – 4.74	0.005

CI, confidence interval. * At least one COPD-related admission within 12 months prior to index admission

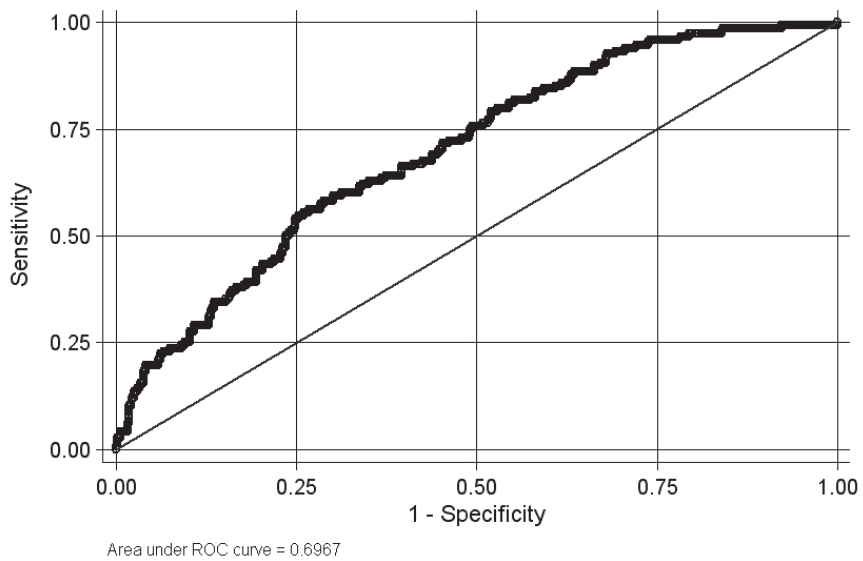
Table 3. Results of multivariate logistic regression analysis of a LOS of >11 days vs ≤11 days during admission for AECOPD (n= 590).

Risk factor	Odds ratio	95% CI	<i>p</i>
Admission Thursday–Saturday	2.24	1.60 – 3.51	<0.001
PaCO ₂ , kPa	1.26	1.13 – 1.42	<0.001
Serum albumin level, g/l	0.92	0.89 – 0.97	0.001
Comorbidities, ≥1 vs 0	2.08	1.08 – 4.02	0.029

CI, confidence interval.

Figure legend

Figure 1. Receiver operating characteristics curve for the multivariate logistic regression model.



RESEARCH ARTICLE

Open Access

Patients with acute exacerbation of chronic obstructive pulmonary disease feel safe when treated at home: a qualitative study

Ying Wang^{1,2*}, Torbjørn Haugen^{1,3}, Sissel Steihaug^{1,4} and Anne Werner¹

Abstract

Background: The design of new interventions to improve health care for patients with chronic obstructive pulmonary disease (COPD) requires knowledge about what patients with an acute exacerbation experience as important and useful. The objective of the study was to explore patients' experiences of an early discharge hospital at home (HaH) treatment programme for exacerbations in COPD.

Methods: Six exacerbated COPD patients that were randomised to receiving HaH care and three patients randomised to receiving traditional hospital care were interviewed in semi-structured in-depth interviews. Four spouses were present during the respective patients' interviews. The interviews were audio-taped, transcribed and analysed by a four-step method for systematic text condensing.

Results: Despite limited assistance from the health care service, the patients and their spouses experienced the HaH treatment as safe. They expressed that information that was adapted to specific situations in their daily lives and given in a familiar environment had positive impact on their self-management of COPD.

Conclusion: The results contribute to increased knowledge and awareness about what the patients experienced as important aspects of a HaH treatment programme. How adapted input from health services can make patients with exacerbation of COPD feel safe and better able to manage their disease, is important knowledge for developing new and effective health services for patients with chronic disease.

Keywords: Hospital at home treatment, Acute exacerbation of COPD, Qualitative interviews, Patient perspective

Background

Chronic obstructive pulmonary disease (COPD) has become a major cause of morbidity and mortality during the last two decades and is expected to become the third leading cause of death worldwide in 2030 [1]. Acute exacerbation of COPD resulting in hospitalisation is a serious event for patients, and frequent hospitalisations have been related to reduced survival [2] and impaired quality of life [3]. Demographic changes with an increasing number of older people with chronic diseases with the demand for acute care hospital beds can be expected to increase. One way of organising help for some of

these patients is to provide hospital at home (HaH) treatment [4].

Different HaH programmes for treatment of acute exacerbation of COPD have been carried out and studied in both randomised controlled studies [5-13], non-randomised studies [14-19] and studies with retrospective analysis [20,21] in countries like the United Kingdom [6,7,12-17], Spain [8,9,19], Australia [10] and Italy [5]. These studies have shown that it is feasible for selected patients with acute exacerbation of COPD to be treated at home, and that the participating patients were satisfied [12,13]. Some studies have found significant cost savings with HaH [9,10,22], but other studies have not been able to confirm this [5,23].

A systematic review from the Norwegian Knowledge Centre for the Health Services concluded that patients with acute exacerbations of COPD, who were randomised to HaH treatment, had a lower readmission rate

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than patients who were randomised to conventional inpatient hospital treatment [22]. Treatment at home showed a statistically non-significant trend towards lower mortality. Finally, the review concluded that it is uncertain whether patients and next of kin are satisfied with receiving HaH treatment [22].

Some qualitative studies have been carried out on patients' experiences of HaH programmes. Clark et al. concluded that not all patients found the home nursing component of the services helpful, and that the patients felt that they were not being actively involved in the early discharge process [23]. Schofield et al. on the other hand found that the majority of the patients and their family preferred home care service rather than hospital care [24]. A qualitative study on experiences of patients with COPD who had participated in an extensive self-management treatment intervention including self-management education course and a fitness programme in an outpatient clinic, found that the patients felt safe [25]. However, a detailed description of the patients' experiences of the home treatment programme is lacking [24,25].

The objective of the present study was to explore COPD patients' experiences of a limited early discharge HaH treatment programme. We concentrated on aspects of special importance to the patients during and after the acute treatment period. Knowledge about what patients experience as helpful health care services and support is needed in development of new ways of organising and carrying out patient treatment.

Methods

Subjects

Patients were recruited from consecutive participants in a randomised controlled trial (RCT), investigating long-term effects of a HaH programme. The main inclusion criteria of the RCT were that the patients were considered to have acute exacerbation of COPD according to the definition adopted by the Global Initiative for Chronic Obstructive Lung Disease (GOLD) [26,27] and needed hospital admission. The main exclusion criteria were life threatening respiratory failure, confusion, impaired consciousness and changes in chest x-ray or comorbidities in need of further inpatient investigation or treatment. Within 36 hours the patients were allocated to HaH or continued hospital treatment. This RCT experienced a slow inclusion rate and was terminated after a year because of this. At this point 12 patients were included.

The 12 patients included in the RCT were considered eligible for inclusion in this qualitative study. After excluding three patients because their medical condition had worsened, all of whom had received in-hospital treatment, nine patients were included (Table 1). Six

patients received HaH treatment (HaH patients) and three received traditional hospital treatment (inpatients). The inpatients were interviewed in order to see the HaH patients' experiences in light of traditional hospital care. Written informed consent was obtained from the participants, and the study was approved by the Regional Committee for Medical Research Ethics (REK), South-East Norway.

The hospital at home treatment programme

A specialised hospital nurse visited the HaH patients up to one hour daily over a period of three days after hospital discharge. The nurse evaluated the patients' clinical status, essential clinical parameters, obtained blood samples for later analysis when needed, and assessed whether or not the patients could still be treated at home. The nurse could consult a pulmonologist in case of worsening of the patients' symptoms. After the consultation, decisions were made on frequency of follow-up, therapy changes or readmission to the hospital. Furthermore, the nurse invited the patient and his/her spouse to a dialogue, e.g. she asked how the patient felt and encouraged them to reflect on possible causes of the acute exacerbation and how to prevent it. During the three-day period the patients were allowed to call the hospital at any time if they were concerned about their condition, especially regarding indications for readmission. Inpatients were treated according to ordinary hospital routines.

Both patient groups were during the subsequent year offered three outpatient follow-up consultations with a pulmonologist in the hospital. The first visit was approximately six weeks after discharge.

Data collection and analysis

The empirical data were obtained from semi-structured, audio-taped in-depth interviews based on Kvale's principles [28]. The researcher had prepared interview guides for the two informant groups (HaH patients and inpatients) before the interview, but the guides were used flexibly. This implied that all the questions in the guide were asked, but different topics could be explored more deeply in different interviews, and that new topics could be brought up by the informants during the interviews. The interviews included questions about the patients' experiences and their benefit of the treatment programme. The interviews were carried out in the patients' home between seven and ten weeks after hospital discharge, except for one interview that was conducted in the outpatient clinic. The interviews lasted between 60 and 90 minutes with the HaH patients, and 30 minutes with the inpatients. Four spouses (three of the HaH patients and one of the inpatients) were present and participated in varying degree. The first author, a medical doctor,

Table 1 Characteristics

<i>Hospital at home treatment programme</i>							<i>Hospital care</i>		
<i>On admission</i>									
<i>Sex</i>	<i>Female</i>	<i>Female</i>	<i>Female</i>	<i>Male</i>	<i>Male</i>	<i>Male</i>	<i>Female</i>	<i>Female</i>	<i>Male</i>
Age (yrs)	51	71	71	70	71	79	54	77	77
Marital status	Married	Widow	Widow	Married	Married	Married	Divorced	Widow	Married
Comorbidities	Anxiety Depression	Heart Disease Hypertension	Heart Disease Hypertension	Hypertension	Diabetes mellitus Hypertension	Diabetes mellitus Hypertension	Anxiety	Diabetes mellitus Inflammatory bowel disease	Heart disease
GOLD stage	II	I	III	III	III	II	III	III	III
Blood pressure (mmHg)	150/80	180/80	140/75	155/90	150/90	140/70	140/75	150/80	97/53
Pulse rate min ⁻¹	108	56	87	75	88	61	105	110	60
PaO ₂ (kPa)	8.27	8.45	10.9	7.57	11.4	8.93	9.18	8.74	8.13
Respiratory rate min ⁻¹	24	22	20	35	24	18	17	20	25
Number of drugs	5	8	8	5	8	10	5	8	8
<i>At 6 weeks control</i>									
FEV ₁ (l/s) (% of predicted)	1.68 (59%)	1.89 (97%)	0.5 (31%)	1.4 (37%)	1.3 (40%)	2.1 (75%)	0.9 (39%)	0.8 (41%)	1.3 (42%)
MRC dyspnoea scale	5	3	3	2	2	2	3	4	2
BMI (kg/m ²)	41	33	24	38	33	30	30	26	24
6-minute walk test (m)	*	508	272	500	125	510	280	350	500

IBD: Inflammatory bowel disease; GOLD: Global Initiative for Chronic Obstructive Lung Disease; PaO₂: arterial oxygen tension; FEV₁: forced expiratory volume in one second; MRC: Medical Research Council dyspnoea scale, range (1–5); BMI: Body mass index; *not carried out due to a knee injury.

carried out and transcribed the interviews. She was trained in asking open-ended rather than closed questions and in asking the participants about not only positive, but also negative experiences with the HaH programme [28]. The analysis was carried out in collaboration with the supervisors.

Interview transcripts constitute our data material. It was analysed according to a systematic text condensing method in the following four steps alternating between the various steps throughout the entire process as described by Malterud [29]: 1) Reading through the whole material to obtain an overall impression; 2) Identifying themes representing different aspects of the patients' experiences and coding these under different thematic headings (i.e. coding groups). The coding groups "feeling safe," "individually adapted information," and "managing strategies" were developed; 3) Abstracting and condensing the content within each coding group; and 4) Summarising the content within each thematic heading. Suitable citations were chosen to illustrate the findings.

The analysis focused on the patients' experiences of the HaH programme, and whether the patients had obtained something from the programme that helped them to manage their chronic illness in everyday life. This was seen in light of the inpatients' experiences of traditional hospital care.

Results

Feeling safe

The patients spontaneously described the HaH programme as safe, mainly according to the daily visits of the nurse. The patients emphasised different aspects of the programme that contributed to their experiences of feeling safe, e.g. the treatment predictability due to the cooperation with the nurse when deciding the time of the visits. Daily examinations of clinical parameters were experienced as "very reassuring." One summed it up as the following:

"It was safe, because I knew she was coming! If I did not feel 100% well, I knew that she was coming tomorrow to check me." (HaH patient 5)

The patients also pointed out the importance of the possibility of telephone consultation with the pulmonary department and instant readmission when needed.

Several patients drew attention to how reassuring it was to have time for asking questions and talking with the nurse during the visits. One HaH patient said:

"The more you know, the safer you feel. You are not so frightened when you know what is what and get a proper explanation of this [disease]." (HaH patient 1)

Four patients appreciated that the nurse would ask, "How are you?" They remarked that she was interested

in listening to how they felt. Some also mentioned the comprehensible way the nurse had explained things and her high competence that made them feel like they were “in safe hands.” The patients used words such as “very pleasant,” “cosy” and “a caring person” to describe the visiting nurse.

Two patients, both readmitted, said that they retrospectively felt that the discharge from the hospital within 36 hours after admission might be too early. However, both patients would choose home treatment again. A third patient wished for a longer home treatment period and perhaps also more than one visit a day.

Four patients emphasised the significance of being followed up with three controls at the hospital during the subsequent year. This contributed to their experience of the programme as reassuring.

The three inpatients said they were very satisfied with the hospital treatment. They were surprised by being asked whether they felt safe during their hospital stay. They expressed that they automatically felt safe after admitted to the hospital. Two of them said that they immediately felt safe when hospitalised, although their breath is still heavy. The statement of one of the patient's wife summed up the three inpatients' experiences as follows:

“I think one feels safe when doctors and nurses are present; I believe it's quite natural!” (Inpatient 3, spouse)

Individually adapted information

The HaH patients emphasised information as important. They valued “getting an explanation” and an understanding of the disease and its consequences. This made them feel safe and calm, as well as less anxious. Four patients and two spouses remarked that the information was detailed and related to concrete situations in their everyday life. One patient stated that being treated at home made it easier to concentrate on her challenges in daily life:

“When you are at home you know what's what, and may think of various things that are relevant just then. It was just me and her and nothing to disturb us.” (HaH patient 1)

One patient's wife appreciated that the nurse had answered several questions concerning her worries for her ill husband, e.g. questions related to breathing, diet and lifestyle. One patient said the nurse had explained many things in a comprehensible way, things she had struggled with without being aware of it:

“She said that I do not need to get everything done in one day even if I am in a good period. I learned to distribute the energy evenly and listen to my body

signals. She made suggestions and put me on the track to many good ideas.” (HaH patient 1)

The nurse had given advice related to how to manage the limitations caused by COPD, be aware of symptoms, e.g. cough, mucus and breathlessness and how to manage them. One patient had been advised to take it easy at the start of physical exertion so that his “breath” would last longer. She also gave advice on dealing with the unpleasant influence of cold air in the winter. Four patients mentioned that the nurse had discussed medication and how to use various medical equipments.

Two patients experienced the nurse's information as less helpful. One said she already had received similar information at a previous rehabilitation programme. Another patient emphasised that the written information he had received from the nurse was not fitting for his specific case:

“There is something about smoking on every page [of the brochure], but I have never smoked!” (HaH patient 3)

According to the three inpatients, the information they got during the hospitalisation was related to treatment and results from various medical examinations. The inpatients noticed that the hospital staff was busy, and they did not expect them to have “time for sitting down talking for half an hour,” as one said. They were surprised when being asked whether there was some information they missed. The following quotation summed up their reactions:

“Is it possible to get any more information?” (Inpatient 2)

Managing strategies

Three of the HaH patients described different aspects of changes in their everyday life related to the received information, explanations and advice about management of the disease from the visiting nurse. One patient shared how he applied the advices: he had learned to relieve the breathlessness during an acute attack by hanging over the armchair in his living room. Earlier he used to swallow the mucus, but he had begun to cough it up even at night now. In order to breathe easier during the night, he had elevated the head end of his bed.

Two patients said they had improved their routines after receiving the HaH. One used to skip prophylactic medication because she did not immediately experience any effect. After she had been given an explanation of how the medication works, she had begun to take it regularly. Another patient used to take a cough mixture before she went to bed to avoid coughing at night. She stopped taking this drug after having been informed about the negative effects of it. She also felt herself in a

better physical and psychological mood after she began to distribute her energy more evenly than before.

The three inpatients did not mention similar experiences from having received information and advice during the hospitalisation. They rather emphasised that they were satisfied with the stay due to the quality of the service from "the nice staff." One said:

"[The staff] was constantly dropping in to ask if I was thirsty or something..." (Inpatient 2)

One inpatient's spouse remarked that she got the impression that the hospital was mostly concentrated on getting patients out.

Discussion

One main result of this study is that the HaH patients' feeling of safety was their main experience from the treatment programme and that this was crucial for their positive experience of the programme. This was surprising considering the limited time of professional treatment. The HaH patients felt they were being taken care of due to the daily visits by the nurse, which seems to contrast the results in another qualitative study [23]. Our analysis clearly indicated that the patients' involvement in deciding the schedule contributed to their feeling of predictability of the treatment programme. That the possibility to call the hospital at any time was highly valued by the patients and probably functioned as a security net, is supported by the results in a qualitative study by Monninkhof et al. [25].

To our knowledge, the importance of feeling safe has previously not been demonstrated in studies on HaH programmes with similar design with relatively limited help as is the case in our study. However, participants in a qualitative study on a considerably more comprehensive programme lasting up to two years expressed that they felt safe [25]. Moreover, two RCTs and one mixed-method study found that the patients were satisfied with and preferred HaH, but it is not in detail described why and what made the participants in their study prefer HaH [12,13,24].

An important finding in our study was that the HaH patients appreciated the individually adapted information they got, including those patients, who previously had undergone a four weeks in-hospital rehabilitation.

The treatment programme took place and the information was given in the patients' home and this made it easier for them to participate in the treatment process, in contrast to passively waiting to be helped, as the inpatients experienced. The home environment provided a unique framework for the treatment and the information. The patients were reminded about what they used to struggle with in their everyday life and the nurse could adjust her answers, information and advice to the

concrete situations and objects in the patients' home and teach them how to manage their disease. The information was therefore related to the patients' needs and easy to remember and practice afterwards.

Another important aspect of the HaH was that the nurse had enough time to talk with one patient at a time without distraction, which routines in the hospital rarely allow. This made it possible for the nurse to practise her role as an adviser, treatment manager and teacher. It is likely that self-management education is beneficial for patients with COPD in a way that the patients apply the knowledge from the education to guide self-management over time [30]. Our findings show that the patients appreciated the calm way the nurse worked, without signalling being in a hurry, as also previously reported to be valued in another study [24]. In contrast, the inpatients' stories reflect how modern care services can be negatively interpreted. The health professionals were perceived to be nice and trying to do a good job, but their work was understood to be distracted by strict routines and technological procedures. The inpatients experienced that the staff was always in a hurry and seemed to have little time for communicating with the patients, but nevertheless appeared to do their best.

During the last five decades chronic diseases are major causes of disabilities, and the aim of the treatment of a chronic disease is to improve health related quality of life and maintain independency for the patients [30]. In the case of COPD, self-management is an important part of living with this disease [31]. To teach patients skills needed to carry out medical regimens and help them manage their illness in everyday life are essential parts of the treatment. Our findings indicated that the individualised information and instructions from the nurse, given in the patients' homes and in connection to their everyday life situations contributed to the patients' experiences of having control and feeling safe.

We chose the qualitative in-depth interview as a method to develop knowledge of the patients' experiences of the HaH. Six HaH patients, selected through the inclusion criteria to the RCT, may seem to be a small number, but is not unusual few informants in a qualitative study [29,32,33]. Although we did not manage to include more than six patients, we had good diversity in our materials as regards age, gender, marital status and GOLD-stage among our subjects (Table 1). In this selected group of patients with COPD, we discovered broadness in the patients' experiences, which we found comparable to studies with higher numbers of patients [24,25].

Additionally, we consider the research method well suited in the sense that we got rich information and new knowledge despite that some patients had difficulties in remembering detailed information. Interviews earlier

than seven to ten weeks after the treatment may have reduced the recall problems in some degree. We believe the involvement of the spouses in the interviews was a valuable informational supplement and interviews with the inpatients shed light on the specific aspects of the HaH.

Conclusion

The patients in this study experienced the HaH programme as safe despite the limited help they received. They expressed that information that was adapted to specific situations in their daily lives and given in a familiar environment had positive impact on their self-management.

How adapted input from health services can make patients with exacerbation of COPD better able to manage their disease, is important knowledge for developing new and effective health services for patients with chronic disease.

Competing interests

The authors declare that they have no competing interests.

Authors' contributions

YW: contributed to design the study, and is main responsible for data collection, analysis and interpretation of data, and drafting of the manuscript. TH: contributed to design the study, and critically revised the article. SS: contributed to the data analysis and critically revised the article. AW: contributed to the study design, data collection, analysis and interpretation of data, drafting, and critically revising the article. All authors read and approved the final manuscript.

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References

- World Health Organization: **COPD burden.** <http://www.who.int/respiratory/copd/burden/en/index.html> 18-5-0011.
- Connors AF Jr, Dawson NV, Thomas C, Harrell FE Jr, Desbiens N, Fulkerson WJ, Kussin P, Bellamy P, Goldman L, Knaus WA: **Outcomes following acute exacerbation of severe chronic obstructive lung disease. The SUPPORT investigators (Study to Understand Prognoses and Preferences for Outcomes and Risks of Treatments).** *Am J Respir Crit Care Med* 1996, **154**:959-967.
- Seemungal TA, Donaldson GC, Paul EA, Bestall JC, Jeffries DJ, Wedzicha JA: **Effect of exacerbation on quality of life in patients with chronic obstructive pulmonary disease.** *Am J Respir Crit Care Med* 1998, **157**:1418-1422.
- Shepperd S, Doll H, Angus RM, Clarke MJ, Iliffe S, Kala L, Ricauda NA, Tibaldi V, Wilson AD: **Avoiding hospital admission through provision of hospital care at home: a systematic review and meta-analysis of individual patient data.** *CMAJ* 2009, **180**:175-182.
- Aimonino RN, Tibaldi V, Leff B, Scarafioti C, Marinello R, Zanolchi M, Molaschi M: **Substitutive "hospital at home" versus inpatient care for elderly patients with exacerbations of chronic obstructive pulmonary disease: a prospective randomized, controlled trial.** *J Am Geriatr Soc* 2008, **56**:493-500.
- Cotton MM, Bucknall CE, Dagg KD, Johnson MK, MacGregor G, Stewart C, Stevenson RD: **Early discharge for patients with exacerbations of chronic obstructive pulmonary disease: a randomized controlled trial.** *Thorax* 2000, **55**:902-906.
- Davies L, Wilkinson M, Bonner S, Calverley PM, Angus RM: **"Hospital at home" versus hospital care in patients with exacerbations of chronic obstructive pulmonary disease: prospective randomised controlled trial.** *BMJ* 2000, **321**:1265-1268.
- Diaz LS, Gonzalez LF, Gomez Mendieta MA, Mayorals AS, Martin AI, Villasante Fernandez-Montes C: **[Evaluation of a home hospitalization program in patients with exacerbations of chronic obstructive pulmonary disease].** *Arch Bronconeumol* 2005, **41**:5-10.
- Hernandez C, Casas A, Escarabill J, Alonso J, Puig-Junoy J, Ferrero E, Vilagut G, Collinient B, Rodriguez-Roisin R, Roca J: **Home hospitalisation of exacerbated chronic obstructive pulmonary disease patients.** *Eur Respir J* 2003, **21**:58-67.
- Nicholson C, Bowler S, Jackson C, Schollay D, Tweeddale M, O'Rourke P: **Cost comparison of hospital- and home-based treatment models for acute chronic obstructive pulmonary disease.** *Aust Health Rev* 2001, **24**:181-187.
- Nissen I, Jensen MS: **Nurse-supported discharge of patients with exacerbation of chronic obstructive pulmonary disease.** *Ugeskr Laeger* 2007, **169**:2220-2223.
- Ojoo JC, Moon T, McGlone S, Martin K, Gardiner ED, Greenstone MA, Morice AH: **Patients' and carers' preferences in two models of care for acute exacerbations of COPD: results of a randomised controlled trial.** *Thorax* 2002, **57**:167-169.
- Skwarska E, Cohen G, Skwarski KM, Lamb C, Bushell D, Parker S, MacNee W: **Randomized controlled trial of supported discharge in patients with exacerbations of chronic obstructive pulmonary disease.** *Thorax* 2000, **55**:907-912.
- Callaghan S: **ACTRITE: Acute Chest Triage Rapid Intervention Team.** *Accid Emerg Nurs* 1999, **7**:42-46.
- Chetty M, MacKenzie M, Douglas G, Currie GP: **Immediate and early discharge for patients with exacerbations of chronic obstructive pulmonary disease: is there a role in "real life"?** *Int J Chron Obstruct Pulmon Dis* 2006, **1**:401-407.
- Davison AG, Monaghan M, Brown D, Eraut CD, O'Brien A, Paul K, Townsend J, Elston C, Ward L, Steeples S, Cubitt L: **Hospital at home for chronic obstructive pulmonary disease: an integrated hospital and community based generic intermediate care service for prevention and early discharge.** *Chron Respir Dis* 2006, **3**:181-185.
- Gravil JH, Al-Rawas OA, Cotton MM, Flanagan U, Irwin A, Stevenson RD: **Home treatment of exacerbations of chronic obstructive pulmonary disease by an acute respiratory assessment service.** *Lancet* 1998, **351**:1853-1855.
- Murphy NM, Byrne CC, O'Neill SJ, McElvaney NG, Costello RW: **An outreach programme for patients with an exacerbation of chronic obstructive pulmonary disease.** *Ir Med J* 2003, **96**:137-140.
- Sala E, Alegre L, Carrera M, Ibars M, Orriols FJ, Blanco ML, Carceles F, Bertran S, Mata F, Font I, Agustí AG: **Supported discharge shortens hospital stay in patients hospitalized because of an exacerbation of COPD.** *Eur Respir J* 2001, **17**:1138-1142.
- Ansari K, Shamsain M, Farrow M, Keaney NP: **Hospital-at-home care for exacerbations of chronic obstructive pulmonary disease: an observational cohort study of patients managed in hospital or by nurse practitioners in the community.** *Chron Respir Dis* 2009, **6**:69-74.
- Lawlor M, Kealy S, Agnew M, Korn B, Quinn J, Cassidy C, Silke B, O'Connell F, O'Donnell R: **Early discharge care with ongoing follow-up support may reduce hospital readmissions in COPD.** *Int J Chron Obstruct Pulmon Dis* 2009, **4**:55-60.
- The Norwegian Knowledge Centre for the Health Services (NOKK): **Intermediære enheter og "hjemmesykehus" ved behandling av pasienter med akutt KOLS-forverring [Intermediate care units and Hospital at home for acute ex-acerbations of COPD].** 2011.

23. Clarke A, Sohanpal R, Wilson G, Taylor S: **Patients' perceptions of early supported discharge for chronic obstructive pulmonary disease: a qualitative study.** *Qual Saf Health Care* 2010, **19**:95–98.
24. Schofield I, Knussen C, Tolson D: **A mixed method study to compare use and experience of hospital care and a nurse-led acute respiratory assessment service offering home care to people with an acute exacerbation of chronic obstructive pulmonary disease.** *Int J Nurs Stud* 2006, **43**:465–476.
25. Monnikhof E, van der Aa M, Van DV, van der Palen J, Zielhuis G, Koning K, Pieterse M: **A qualitative evaluation of a comprehensive self-management programme for COPD patients: effectiveness from the patients' perspective.** *Patient Educ Couns* 2004, **55**:177–184.
26. Burge S, Wedzicha JA: **COPD exacerbations: definitions and classifications.** *Eur Respir J Suppl* 2003, **41**:46s–53s.
27. Global Initiative for Chronic Obstructive Lung Disease (GOLD): **Global Strategy for the Diagnosis, Management and Prevention of COPD.** 2011.
28. Kvale S, Brinkmann S: *InterViews: learning the craft of qualitative research interviewing*. Sage Publications Inc; 2008. <http://books.google.com/books?id=bZGvwsP1BRwC>.
29. Malterud K: **Qualitative research: standards, challenges, and guidelines.** *Lancet* 2001, **358**:483–488.
30. Holman H, Lorig K: **Patient self-management: a key to effectiveness and efficiency in care of chronic disease.** *Public Health Rep* 2004, **119**:239–243.
31. Bourbeau J: **Disease management for COPD: avoiding hospitalizations and controlling cost?** *COPD* 2011, **8**:143–144.
32. Taylor S, Eldridge S, Chang YM, Sohanpal R, Clarke A: **Evaluating hospital at home and early discharge schemes for patients with an acute exacerbation of COPD.** *Chron Respir Dis* 2007, **4**:33–43.
33. Kuzel AJ: **Sampling in qualitative inquiry.** In *Doing Qualitative research*. 2nd edition. Edited by Crabtree BF, Miller WL. Thousand Oaks, California: Sage Publication Inc; 1999:33–35.

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